ACTA·COLL·MED·PHILAD·INSTIT·A·D·MDCCLXXXVII

☞ *Please sign and return this slip to CHARLES PERRY FISHER, Librarian*

College of Physicians of Philadelphia

19 S. 22d St., Philadelphia, U. S. A.

Received,..... 19 , Volume

Transactions of the College of Physicians of Philadelphia.

Name,.....

Address,.....

TRANSACTIONS

OF THE

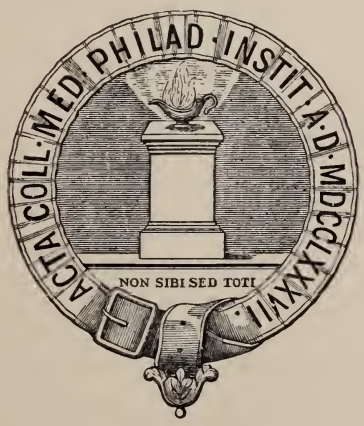
COLLEGE OF PHYSICIANS

OF

PHILADELPHIA

THIRD SERIES

VOLUME THE THIRTY-SECOND



PHILADELPHIA
PRINTED FOR THE COLLEGE
1910

NOTICE.

The present volume of TRANSACTIONS contains the papers read before the College from January, 1910, to December, 1910, inclusive.

The Committee of Publication thinks it proper to say that the College holds itself in no way responsible for the statements, reasonings, or opinions set forth in the various papers published in its TRANSACTIONS.

EDITED BY

WILLIAM ZENTMAYER

DORNAN, PRINTER

COLLEGE OF PHYSICIANS OF PHILADELPHIA

1910

OFFICERS AND STANDING COMMITTEES

PRESIDENT.

GEORGE E. DE SCHWEINITZ, M.D.

VICE-PRESIDENT.

WHARTON SINKLER, M.D.[1]
JAMES C. WILSON, M.D.[2]

CENSORS.

RICHARD A. CLEEMANN, M.D.
S. WEIR MITCHELL, M.D.
LOUIS STARR, M.D.
ARTHUR V. MEIGS, M.D.

SECRETARY.

THOMAS R. NEILSON, M.D.

TREASURER.

RICHARD H. HARTE, M.D.

HONORARY LIBRARIAN.

FREDERICK P. HENRY, M.D.

COUNCILLORS.

To serve until January, 1911.

ROBERT G. LE CONTE, M.D.
GEORGE W. NORRIS, M.D.

To serve until January, 1912.

JOHN H. GIBBON, M.D.
WILLIAM PEPPER, M.D.

To serve until January, 1913.

DAVID L. EDSALL, M.D.
CHARLES W. BURR, M.D.

COMMITTEE OF PUBLICATION.

GWILYM G. DAVIS, M.D., *Ch'n.*
THOMPSON S. WESTCOTT, M.D.
WILLIAM ZENTMAYER, M.D.

LIBRARY COMMITTEE.

WILLIAM J. TAYLOR, M.D., *Ch'n.*
S. WEIR MITCHELL, M.D.
FRANCIS R. PACKARD, M.D.
GEORGE W. NORRIS, M.D.
ASTLEY P. C. ASHHURST, M.D.
The HONORARY LIBRARIAN, *ex-officio*

COMMITTEE ON MÜTTER MUSEUM.

GEORGE MCCLELLAN, M.D., *Ch'n.*
HENRY MORRIS, M.D.
GEORGE P. MÜLLER, M.D.

[1] Died March 16, 1910.

[2] Elected June 1, 1910.

HALL COMMITTEE.

J. K. Mitchell, M.D., *Ch'n.* B. Alex. Randall, M.D.
Thomas H. Fenton, M.D. E. Hollingsworth Siter, M.D.
A. O. J. Kelly, M.D.

COMMITTEE ON THE DIRECTORY FOR NURSES

James C. Wilson, M.D., *Ch'n.*[1] Wharton Sinkler, M.D.[2]
Thomas G. Ashton, M.D. Frederick Fraley, M.D.[3]
John H. Gibbon, M.D.[4]

COMMITTEE ON FINANCE.

John B. Roberts, M.D., *Ch'n.* George Fales Baker, M.D.
Samuel G. Dixon, M.D.
The President and the Treasurer, *ex-officio.*

COMMITTEE ON ENTERTAINMENTS.

Charles H. Frazier, M.D., *Ch'n.* Alfred R. Allen, M.D.
Alfred Stengel, M.D. Francis W. Sinkler, M.D.
The President, *ex-officio.*

COMMITTEE ON SCIENTIFIC BUSINESS.

A. O. J. Kelly, M.D., *Ch'n.* William R. Nicholson, Jr., M.D.
J. Chalmers Da Costa, M.D.
The President and the Secretary, *ex-officio.*

COMMITTEE ON THE ALVARENGA PRIZE.

H. A. Hare, M.D., *Ch'n.* W. L. Rodman, M.D.
David Reisman, M.D. W. T. Shoemaker, M.D.
J. G. Clark, M.D.

COMMITTEE ON THE NATHAN LEWIS HATFIELD PRIZE (until Feb. 1913).

J. H. Musser, M.D., *Ch'n.* F. X. Dercum, M.D.
W. T. Longcope, M.D.

TRUSTEES OF THE NATHAN LEWIS HATFIELD MEMORIAL FUND.

Robert G. Le Conte, M.D. Norton Downs, M.D.
Francis R. Packard, M.D.

SECTIONS.

Ophthalmology—*Chairman,* William Zentmayer, M.D.
Clerk, T. B. Holloway, M.D.

Otology and Laryngology—*Chairman,* A. W. Watson, M.D.
Clerk, Ralph Butler, M.D.

General Medicine—*Chairman,* J. C. Da Costa, Jr., M.D.
Clerk, C. B. Farr, M.D.

Medical History—*Chairman,* R. G. Curtin, M.D.
Clerk, ———

[1] Resigned November 2, 1910.
[2] Resigned February 2, 1910.
[3] Elected March 2, 1910.
[4] Elected December 7, 1910.

LIST

OF THE

PRESIDENTS OF THE COLLEGE FROM THE TIME OF ITS INSTITUTION

ELECTED	
1787	JOHN REDMAN
1805	WILLIAM SHIPPEN
1809	ADAM KUHN
1818	THOMAS PARKE
1835	THOMAS C. JAMES[1]
1835	THOMAS T. HEWSON
1848	GEORGE B. WOOD
1879	W. S. W. RUSCHENBERGER
1883	ALFRED STILLÉ
1884	SAMUEL LEWIS[2]
1884	J. M. DA COSTA
1886	S. WEIR MITCHELL
1889	D. HAYES AGNEW
1892	S. WEIR MITCHELL
1895	J. M. DA COSTA
1898	JOHN ASHHURST, JR.
1900	W. W. KEEN
1902	HORATIO C. WOOD
1904	ARTHUR V. MEIGS
1907	JAMES TYSON
1910	GEORGE E. DE SCHWEINITZ

[1] Died four months after his election.
[2] Resigned on account of ill-health.

FELLOWS

OF THE

COLLEGE OF PHYSICIANS OF PHILADELPHIA

DECEMBER, 1910

* Non-resident Fellows.
† Fellows who have commuted dues.

ELECTED

1892. Abbott, Alexander C., M.D., Sc.D. (Hon.), Professor of Hygiene and Bacteriology in the University of Pennsylvania; Member of the Board of Health of Philadelphia. 4229 Baltimore Ave.

1905. Adler, Lewis H., Jr., M.D., Professor of Diseases of the Rectum in the Philadelphia Polyclinic and College for Graduates in Medicine; formerly Prosector to the Professor of Anatomy in the University of Pennsylvania; Secretary-Treasurer of the American Proctologic Society; Consulting Surgeon to the Charity Hospital. 1610 Arch St.

1903. Allen, Alfred Reginald, M.D. Lecturer on Neurological Electro-Therapeutics and Instructor in Neurology and Neuropathology in the University of Pennsylvania. 111 S. Twenty-first St.

1906. Allen, Francis Olcott, Jr., A.B., M.D., Surgeon to the Dispensaries of the Presbyterian, Methodist, and Pennsylvania Hospitals. 2216 Walnut St.

1896. Allyn, Herman B., M.D., Associate in Medicine in the University of Pennsylvania; Physician to the Philadelphia General Hospital. 501 S. Forty-second St.

1888. Anders, James M., M.D., LL.D., Professor of the Theory and Practice of Medicine and Clinical Medicine in the Medico-Chirurgical College; Consulting Physician to the Jewish Hospital Association, Philadelphia. 1605 Walnut St.

ELECTED

1905. Anspach, Brooke M., M.D., Associate in Gynecology in the University of Pennsylvania; Assistant Gynecologist to the University Hospital; Gynecologist and Obstetrician to the Philadelphia General Hospital; Gynecologist to the Stetson Hospital. 119 S. Twentieth St.

1905. Appleman, Leighton F., M.D., Demonstrator of Pharmacy and Materia Medica, and Instructor in Therapeutics in the Jefferson Medical College; Instructor in Ophthalmology in the Philadelphia Polyclinic and College for Graduates in Medicine; Ophthalmologist to the Frederick Douglass Memorial Hospital. 308 S. Sixteenth St.

1906. Ashhurst, Astley P. C., A.B., M.D., Surgeon to the Dispensary of the Episcopal and of the Children's Hospitals; Assistant Surgeon to the Orthopædic Hospital; Chief of the Gynecological Dispensary of the Pennsylvania Hospital; Prosector to the Associate Professor of Applied Anatomy in the University of Pennsylvania. 811 Spruce St.

1893. Ashton, Thomas G., M.D., Adjunct Professor of Medicine in the University of Pennsylvania; Physician to the Philadelphia General Hospital. 1814 S. Rittenhouse Square.

1906. Babbitt, James A., A.B. (Yale), A.M. (Haverford), M.D., Physical Director and Associate Professor of Physiology at Haverford College; Assistant Laryngologist and Aurist to the German Hospital, and Chief of the Out-patient Department for Diseases of the Nose, Throat, and Ear; Laryngologist to the Dispensary of the Children's Hospital; Assistant in the Dispensary for Diseases of the Ear, University Hospital. 121 S. Eighteenth St.

1852. Bache, Thomas Hewson, M.D. 233 S. Thirteenth St.

1903. Bacon, John, M.D. Torresdale, Pa.

1910. Baer, Benjamin F., Jr., M.D. 2040 Chestnut St.

†1892. Baker, George Fales, B.S., M.D. 1818 Spruce St.

1889. Baldy, John Montgomery, M.D., Professor of Gynecology in the Philadelphia Polyclinic; Surgeon to the Gynecean Hospital; Consulting Surgeon to the Jewish and the Frederick Douglass Memorial Hospitals. 2219 De Lancey Place.

1898. Balliet, Tilghman M., A.M., M.D., Professor of Therapeutics at Dartmouth College, Hanover, N. H.; Physician to the Old Man's Home. 3709 Powelton Ave.

1883. Baum, Charles, A.M., M.D., Ph.D. 1828 Wallace St.

ELECTED

1908. Beardsley, Edward J. G., M.D., L.R.C.P. (Lond.), Chief of the Out-patient Medical Department of the Jefferson Medical College Hospital; Demonstrator of Physical Diagnosis and Clinical Medicine in the Jefferson Medical College; Physician to the Byberry Branch of the Philadelphia Hospital; Assistant Physician to the Philadelphia General Hospital. 2030 Chestnut St.

1883. Beates, Henry, Jr., M.D., M.S. 260 S. Sixteenth St.

1874. Bennett, W. H., A.M., M.D., Physician-in-Charge of the Seashore House for Invalid Children, and of the Seaside House for Invalid Women, Atlantic City; formerly Physician to the Episcopal Hospital, and Physician-in-Charge of St. Christopher's Hospital for Children. 1837 Chestnut St.

1896. Beyea, Henry D., M.D., Associate in Gynecology and Assistant Demonstrator of Obstetrics in the University of Pennsylvania; Assistant Surgeon to the Gynecean Hospital. 1734 Spruce St.

†1884. Biddle, Alexander W., M.D. Chestnut Hill.

1884. Biddle, Thomas, M.D. 122 S. Twenty-second St.

*1903. Biggs, Montgomery H., M.D. Rutherfordton, N. C.

1908. Bland, Pascal Brooke, M.D., Chief Clinical Assistant in the Gynecological Department of the Jefferson Medical College Hospital; Instructor in Gynecology in the Jefferson Medical College; Gynecologist to St. Joseph's Hospital; Assistant Gynecologist to the Philadelphia General Hospital. 1729 Pine St.

1894. Bliss, Arthur Ames, A.M., M.D. 117 S. Twentieth St.

1894. Bochroch, Max H., M.D., Demonstrator of Neurology and Chief Clinical Assistant in the Nervous Department of the Jefferson Medical College Hospital; Neurologist to the Out-patient Department of St. Joseph's Hospital. 1539 Pine St.

1896. Boger, John A., A.M., M.D., Surgeon to St. Mary's Hospital; Surgeon to the Stetson Hospital; Surgeon to the Dispensary of the Episcopal Hospital. 2213 N. Broad St.

1910. Boice, J. Morton, M.D., Gynecologist to the Out-patient Department of St. Joseph's Hospital; Lecturer on Chemistry to the Training School of St. Joseph's Hospital. 2035 Chestnut St.

1891. Boyd, George M., M.D., Professor of Obstetrics in the Medico-Chirurgical College; Obstetrician to the Medico-

ELECTED

Chirurgical Hospital; Physician to the Philadelphia Lying-in Charity; Obstetrician and Gynecologist to the Philadelphia General Hospital. 1909 Spruce St.

1907. Boyer, Henry Percival, M.D., Physician to the Stetson Hospital; Assistant Physician to the Orthopædic Hospital and Infirmary for Nervous Diseases. 4602 Baltimore Ave.

†1884. Bradford, T. Hewson, M.D., Medical Director of the Philadelphia Life Insurance Company; Medical Director of the United Security Life Insurance and Trust Company; Attending Physician to St. Martin's College for Destitute Boys. 1802 De Lancey Place.

1907. Bradley, William N., Ph.G., M.D., Assistant Physician to the Medical Dispensary of the Children's Hospital; Assistant Physician to the Out-patient Department of the Pennsylvania Hospital, Assistant Physician to the Out-patient Department of the Orthopædic Hospital. 1532 S. Sixth St.

1903. Branson, Thomas F., M.D., Attending Physician to the Bryn Mawr Hospital. Rosemont, Pa.

1891. Brinton, Lewis, M.D., Physician-in-Chief of the American Hospital for Diseases of the Stomach. 1933 Spruce St.

1900. Brinton, Ward, A.M., M.D., Visiting Physician to the Tuberculosis Department of the Philadelphia General Hospital; Visiting Physician to the Hospital for Poor Consumptives, at White Haven, Pa.; Visiting Physician to the Henry Phipps Institute for the Prevention, Treatment, and Cure of Tuberculosis; Visiting Physician to the Philadelphia Jewish Sanatorium for Consumptives. 1423 Spruce St.

1907. Brooks, Macy, A.B. (Princeton), M.D., Assistant Genito-urinary Surgeon to the Philadelphia General Hospital. 1314 Spruce St.

1887. Brubaker, Albert P., A.M., M.D., Professor of Physiology and Medical Jurisprudence in the Jefferson Medical College; Professor of Physiology and Hygiene in the Drexel Institute of Science, Art, and Industry. 105 N. Thirty-fourth St.

1851. Bullock, William R., M.D. 6439 Green St., Germantown, Phila.

1906. Burns, Stillwell C., M.D., Lecturer on Surgery in the Medico-Chirurgical College; Assistant Surgeon to the Medico-Chirurgical Hospital. 1326 Spring Garden St.

ELECTED

1892. Burr, Charles W., M.D., Professor of Mental Diseases in the University of Pennsylvania; Neurologist to the Philadelphia General Hospital. 1327 Spruce St.

1906. Butler, Ralph, M.D., Chief of the Dispensary for Diseases of the Ear at the University Hospital; Laryngologist and Aurist to the German Hospital; Assistant Laryngologist to the Philadelphia General Hospital; Associate Professor of Otology in the Philadelphia Polyclinic. 1824 Chestnut St.

*1908. Cadbury, William W., A.M., M.D., University Medical School, Canton, China.

†1907. Cadwalader, Williams B., M.D., Pathologist and Clinical Assistant to the Orthopædic Hospital and Infirmary for Nervous Diseases; Assistant Instructor in Nervous Diseases in the Philadelphia Polyclinic. 1710 Locust St.

1905. Cameron, George A., M.D., Physician to the Germantown Hospital. S. E. cor. Schoolhouse Lane and Greene St., Germantown.

1905. Carmany, Harry S., M.D., Surgeon to St. Timothy's Hospital, Roxborough; Surgeon to the Dispensary of the Episcopal Hospital. 366 Green Lane, Roxborough.

1910. Carnett, John Berton, M.D., Associate in Surgery in the University of Pennsylvania; Assistant Surgeon to the University and the Philadelphia General Hospitals; Surgeon to the Chestnut Hill Hospital; Consulting Surgeon to the Henry Phipps Institute, to the Phœnixville Hospital, and to the Eastern Pennsylvania Institution for the Feeble-minded and Epileptic. 318 S. Fifteenth St.

1905. Carpenter, Herbert B., M.D., Physician to the Dispensary of the Children's Hospital. 1805 Spruce St.

1895. Carpenter, John T., M.D., Lecturer on Ophthalmology in the University of Pennsylvania; Assistant Ophthalmic Surgeon to the University Hospital; Attending Ophthalmologist to the Bryn Mawr Hospital. 2040 Chestnut St.

1892. Cattell, Henry W., A.M., M.D., Editor of *International Clinics*, of *Medical Notes and Queries*, and of *Lippincott's Medical Dictionary;* Author of *Postmortem Pathology*. 3709 Spruce St.

1900. Chance, Burton, M.D., Assistant Surgeon to the Wills Eye Hospital. 235 S. Thirteenth St.

1885. Chapin, John B., M.D., LL.D. (Jefferson and Williams), Physician-in-Chief to the Pennsylvania Hospital for the Insane. Pennsylvania Hospital for the Insane.

ELECTED

1900. Chase, Robert Howland, A.M., M.D., Superintendent of the Friends' Asylum for the Insane. Friends' Asylum, Frankford.

*1868. Cheston, D. Murray, M.D. Harwood P. O., Md.

1897. Cheston, Radcliffe, M.D., Visiting Physician to the Chestnut Hill Hospital; Consulting Physician to the Germantown Hospital and to the Pennsylvania Institution for the Deaf and Dumb. Chestnut Hill.

1904. Christian, Hilary M., M.D., Clinical Professor of Genito-urinary Diseases in the Medico-Chirurgical College; Professor of Genito-urinary Diseases in the Philadelphia Polyclinic and College for Graduates in Medicine. 1321 Spruce St.

1903. Chrystie, Walter, M.D. Bryn Mawr, Pa.

1899. Clark, John G., M.D., Professor of Gynecology in the University of Pennsylvania; Gynecologist-in-Chief to the University Hospital. 2017 Walnut St.

1897. Claxton, Charles, A.M., M.D. 5137 Morris St., Germantown.

1872. Cleemann, Richard A., M.D. 2135 Spruce St.

1896. Cleveland, Arthur H., M.D., Clinical Professor of Laryngology in the Medico-Chirurgical College; Laryngologist to the Medico-Chirurgical Hospital; Laryngologist and Aurist to the Presbyterian Hospital, and to the Pennsylvania Institution for the Deaf and Dumb. 256 S. Fifteenth St.

1910. Cloud, J. Howard, M.D. 7 W. Lancaster Avenue, Ardmore, Pa.

1903. Coates, George Morrison, A.B., M.D., Professor of Diseases of the Ear in the Philadelphia Polyclinic; Assistant Laryngologist to the Pennsylvania Hospital; Laryngologist to the Pennsylvania Institution for the Instruction of the Blind; Laryngologist to the Philadelphia Orphanage. 2032 Chestnut St.

1908. Codman, Charles A. E., M.D., Physician to the American Oncologic Hospital. 4116 Spruce St.

1907. Cohen, Myer Solis, A.B., M.D., Consulting Physician to the Hospital for Diseases of the Lungs, Chestnut Hill; Assistant Physician to the Philadelphia General Hospital; Pediatrician to the Dispensary of the Jewish Hospital; Visiting Physician to the Philadelphia Jewish Sanatorium for Consumptives. 4102 Girard Ave.

1888. Cohen, Solomon Solis, M.D., Professor of Clinical Medicine in the Jefferson Medical College; Physician to the Jefferson

ELECTED

Medical College Hospital, to the Philadelphia General Hospital, to the Jewish Hospital, and to the Rush Hospital. 1525 Walnut St.

1898. Coles, Stricker, M.D., Assistant Professor of Obstetrics in the Jefferson Medical College; Assistant Obstetrician to the Jefferson and the Philadelphia General Hospitals. 2103 Walnut St.

1901. Coley, Thomas Luther, A.B., M.D., Attending Physician to the Methodist Episcopal Hospital of Philadelphia. 338 S. Twenty-first St.

1903. Cooper, J. Cardeen, M.D., Consulting Physician to the Methodist Home for the Aged. 247 S. Seventeenth St.

1903. Coplin, W. M. L., M.D., Professor of Pathology in the Jefferson Medical College; Pathologist to and Director of the Laboratories of the Jefferson Medical College Hospital; Pathologist to the Philadelphia General Hospital and to the Friends' Asylum for the Insane, Frankford; Bacteriologist to the Pennsylvania State Board of Health. 606 South Forty-eighth St.

1907. Council, Malcolm S., M.D., Attending Physician to the Bryn Mawr Hospital; Attending Physician to the Cathcart Home at Devon. Bryn Mawr, Pa.

1909. Craig, Alexander R., A.M., M.D., Assistant Surgeon to the Methodist Hospital; Assistant Laryngologist to the Dispensary of the Children's Hospital. 4051 Spruce St.

1904. Craig, Frank A., M.D., Assistant Instructor in Medicine in the University of Pennsylvania; Member of Staff of the Henry Phipps Institute; Examining Physician to the Free Hospital for Poor Consumptives. 732 Pine St.

1907. Crampton, George S., M.D. 1700 Walnut St.

1895. Cross, William A., M.D., Consulting Physician to the Jewish Hospital. Jenkintown, Pa.

1904. Cruice, John M., M.D., Instructor in Medicine in the University of Pennsylvania; Assistant Physician to the Philadelphia General Hospital; Physician to the Medical Dispensary of the University Hospital and of St. Joseph's Hospital. 1815 Spruce St.

1910. Cummins, W. Taylor, M.D., Demonstrator of Pathology in the Woman's Medical College of Pennsylvania; Assistant Demonstrator of Pathology in the University of Pennsylvania; Pathologist (acting) to the Methodist Episcopal Hospital. 226 S. Fifty-third St.

ELECTED

1902. Currie, Charles A., M.D., Physician to the Germantown Hospital. West Walnut Lane, Germantown.

1884. Curtin, Roland Gideon, A.M., M.D., Ph.D., Emeritus Physician to the Philadelphia General Hospital; Consulting Physician to the Presbyterian, St. Timothy's, and the Jewish Hospitals. 22 S. Eighteenth St.

1903. Da Costa, John C., Jr., M.D., Assistant Professor of Clinical Medicine in the Jefferson Medical College; Assistant Physician to the Jefferson Medical College Hospital; Hematologist to the German Hospital; Associate Member of the Association of American Physicians. 1022 Spruce St.

1896. Da Costa, John Chalmers, M.D., Professor of the Principles of Surgery and of Clinical Surgery in the Jefferson Medical College; Surgeon to the Philadelphia General and St. Joseph's Hospitals. 2045 Walnut St.

1887. Daland, Judson, M.D., Professor of Clinical Medicine in the Medico-Chirurgical College; Physician to the Medico-Chirurgical Hospital. 317 S. Eighteenth St.

1859. Darrach, James, M.D., Consulting Surgeon to the Germantown Hospital. 5923 Greene St., Germantown.

1896. Davis, Charles N., M.D., Dermatologist to the Pennsylvania Hospital; Consulting Dermatologist to St. Agnes' Hospital; Assistant Physician to the Dispensary for Skin Diseases in the Howard Hospital. 1931 Spruce St.

1888. Davis, Edward P., A.M., M.D., Professor of Obstetrics in the Jefferson Medical College and in the Philadelphia Polyclinic; Visiting Obstetrician to the Jefferson and the Polyclinic Hospitals; Obstetrician and Gynecologist to the Philadelphia General Hospital; Member of the American Gynecological Society, the American Pediatric Society, and of the International Congress of Obstetrics and Gynecology. 250 S. Twenty-first St.

1889. Davis, Gwilym G., M.D. (Univ. of Penna. and Göttingen), M.R.C.S. England, Associate Professor of Applied Anatomy in the University of Pennsylvania; Surgeon to St. Joseph's and the Orthopædic Hospitals; Orthopedic Surgeon to the Philadelphia General Hospital. 1814 Spruce St.

1900. Davisson, Alex. Heron, M.D. 31 St. Paul's Road, Ardmore.

ELECTED

1894. Deaver, Harry C., M.D., Professor of Surgery in the Woman's Medical College of Pennsylvania; Surgeon to the Episcopal and the Stetson Hospitals, and to the Children's Hospital of the Mary J. Drexel Home. 1534 N. Fifteenth St.

1887. Deaver, John B., M.D., Surgeon-in-Chief to the German Hospital; Consulting Surgeon to the Germantown Hospital. 1634 Walnut St.

1892. Deaver, Richard Wilmot, M.D., Consulting Surgeon to the Germantown Hospital. 6105 Main St., Germantown.

1902. Dehoney, Howard, M.D. 237 S. Thirteenth St.

1885. Dercum, Francis X., A.M., M.D., Ph.D., Professor of Nervous and Mental Diseases in the Jefferson Medical College; Neurologist to the Philadelphia General Hospital; Foreign Corresponding Member of the Neurological Society of Paris. 1719 Walnut St.

1908. Despard, Duncan L., M.D., Instructor in Surgery in Jefferson Medical College; Chief Assistant in the Surgical Clinic at Jefferson Medical College Hospital. 1806 Pine St.

1908. Dillard, Henry K., Jr., M.D., Physician to the Mary J. Drexel Home at the German Hospital. 234 S. Twentieth St.

1891. Dixon, Samuel G., M.D., Commissioner of Health of the Commonwealth of Pennsylvania; President of the Academy of Natural Sciences of Philadelphia; First Vice-President of the Zoölogical Society of Philadelphia; Member of the Board of Directors of the Wistar Institute of Anatomy of the University of Pennsylvania. Ardmore, Pa.

*1896. Donnellan, P. S., M.D., L.R.C.S. and P., Ireland. 151 E. Third St., Williamsport, Pa.

*1897. Dorland, W. A. Newman, M.D., Professor of Obstetrics in the Loyola University of Illinois. 1422 W. Jackson Boulevard, Chicago, Ill.

1907. Dorrance, George Morris, M.D., Assistant Surgeon to St. Agnes' Hospital; Assistant Oral Surgeon to the Philadelphia General Hospital; Instructor in Surgery in the Philadelphia Polyclinic; Demonstrator of Anatomy in the Dental Department of the University of Pennsylvania. 2025 Walnut St.

ELECTED

1902. Dougherty, Sherborne W., M.D., Instructor in Physical Diagnosis in the University of Pennsylvania; Physician to the Dispensary of the German Hospital; Assistant Physician to the Methodist Hospital. 256 S. Sixteenth St.

1893. Downs, Norton, M.D. Fordhooke Farms, Three Tuns, Pa.

1864. Downs, R. N., M.D., Consulting Physician to the Germantown Hospital. 5916 Greene St., Germantown.

1902. Downs, Robert N., Jr., M.D., Surgeon to the Dispensary of the Germantown Hospital. 6008 Greene St., Germantown.

1910. Drayton, William, Jr., M.D., Assistant Physician to the Out-patient Department of the Pennsylvania Hospital; Clinical Assistant at the Orthopædic Hospital and Infirmary for Nervous Diseases; Physician to St. Michael's Parish School. 1316 Locust St.

1864. Duer, Edward L., A.M., M.D., Gynecologist to the Presbyterian Hospital; Consulting Obstetrician to the Maternity Hospital and to the Preston Retreat. 1606 Locust St.

1897. Duer, S. Naudain, M.D., Physician to the Dispensary of the Presbyterian Hospital. 1916 Pine St.

1871. Duhring, L. A., M.D., Professor of Diseases of the Skin in the University of Pennsylvania; Honorary Member of the Dermatological Society of London, Società Itãliana di Dermatologia e Sifilographia, and Wiener Dermatologische Gesellschaft. 3322 Walnut St.

1881. Dulles, Charles Winslow, M.D., Consulting Surgeon of the Rush Hospital. 4101 Walnut St.

*1860. Dunton, William R., M.D. Montrose, Pa.

1899. Edsall, David L., M.D., Professor of Medicine in the University of Pennsylvania; Physician to the Episcopal Hospital. 1432 Pine St.

*1887. Edwards, William A., M.D., Professor of Pediatrics in the Medical Department of the University of California. Fifth and Spring Sts., Los Angeles, Cal.

1904. Elmer, Walter G., B.S., M.D., Instructor in Orthopedic Surgery in the University of Pennsylvania; Assistant Orthopedic Surgeon to the University Hospital; Orthopedic Surgeon to the Jewish Hospital; Surgeon to the Pennsylvania Training School for Children. 1801 Pine St.

ELECTED

1896. Ely, Thomas C., A.M., M.D. 2041 Green St.

1901. Erck, Theodore A., M.D., Assistant Surgeon to the Gynecean Hospital; Associate in Gynecology in the Philadelphia Polyclinic and College for Graduates in Medicine; Gynecologist to the Frederick Douglass Memorial Hospital. 251 S. Thirteenth St.

1893. Eshner, Augustus A., M.D., Professor of Clinical Medicine in the Philadelphia Polyclinic and College for Graduates in Medicine; Physician to the Philadelphia General Hospital; Assistant Physician to the Orthopædic Hospital and Infirmary for Nervous Diseases; Consulting Physician to Mercy Hospital. 1019 Spruce St.

*1905. Evans, Joseph S., Jr., A.B., M.D., Professor of Clinical Medicine and Students' Physician in the University of Wisconsin. University of Wisconsin, Madison, Wis.

1905. Evans, William, M.D. 4007 Chestnut St.

1894. Faries, Randolph, M.D. 2007 Walnut St.

†1903. Farr, Clifford B., A.B., M.D., Professor of Diseases of the Stomach, etc., in the Philadelphia Polyclinic; Instructor in Medicine in the University of Pennsylvania; Assistant Physician to the Philadelphia General Hospital; Pathologist to the Presbyterian Hospital. 211 S. Seventeenth St.

1893. Farr, William W., M.D., Physician to the Leamy Home. 117 Allen's Lane, Mount Airy.

1884. Fenton, Thomas H., M.D., Ophthalmologist to St. Vincent's Home, to the Home for Aged Couples, to the Baptist Home, and to the House of the Good Shepherd. 1319 Spruce St.

1907. Ferguson, Albert D., M.D., Visiting Physician to the Widener Memorial School for Crippled Children. 50 E. Johnson St., Germantown.

1907. Fetterolf, George, A.B., M.D., Laryngologist to the Henry Phipps Institute for Tuberculosis; Laryngologist to the White Haven Sanatorium; Consulting Laryngologist to the Phœnixville Hospital; Demonstrator of Anatomy in the University of Pennsylvania. 330 S. Sixteenth St.

1907. Fife, Charles A., A.B., M.D., Instructor in Diseases of Children, and Associate in the William Pepper Clinical Laboratory in the University of Pennsylvania; Physician

ELECTED

to St. Christopher's Hospital for Children, to the Children's Department of the Presbyterian Hospital, and to the Children's Department of the Mary J. Drexel Home; Assistant Pediatrist to the Philadelphia General Hospital; Visiting Physician to St. Vincent's Home. 2033 Locust St.

1910. Fisher, John Monroe. M.D., Associate Professor of Gynecology in the Jefferson Medical College; Gynecologist to the Philadelphia, St. Agnes', and Phœnixville Hospitals; Assistant Gynecologist to the Jefferson Medical College Hospital. 222 S. Fifteenth St.

1884. Fisher, Henry M., M.D. 1027 Pine St.

1888. Flick, Lawrence F., M.D. 736 Pine St.

1908. Foulkrod, Collin, M.D., Assistant Obstetrician to the Presbyterian Hospital Maternity; Assistant Demonstrator of Obstetrics in Jefferson Medical College; Gynecologist to the Dispensary of the Presbyterian Hospital. 4022 Chestnut St.

1908. Fox, Herbert, M.D., Chief of the Laboratories of the Pennsylvania Department of Health; Pathologist to the Laboratory of Comparative Pathology of the Zoölogical Society of Philadelphia; Pathologist to the Rush Hospital. 3902 Locust St.

†1885. Fox, Joseph M., M.D. Torresdale, Pa.

1906. Fraley, Frederick, Jr., A.B., M.D. 314 S. Seventeenth St.

1903. Francine, Albert P., A.M., M.D., Instructor in Medicine in the University of Pennsylvania; Physician to the Medical Dispensary of the University Hospital; Attending Physician to the Philadelphia General Hospital, Department of Tuberculosis; Chief Physician to the State Dispensary for Tuberculosis, Philadelphia. 218 S. Fifteenth St.

1897. Frazier, Charles H., M.D., Professor of Clinical Surgery in the University of Pennsylvania; Surgeon to the University, the Philadelphia General, and the Episcopal Hospitals; Surgeon to the Home for Crippled Children. 1724 Spruce St.

†1890. Freeman, Walter J., M.D., Emeritus Professor of Laryngology in the Philadelphia Polyclinic; Laryngologist to the Orthopædic Hospital; Consulting Laryngologist to the Pennsylvania Institution for the Deaf and Dumb. 1832 Spruce St.

1910. Frescoln, Leonard D., M.D., Assistant Chief Resident Physician, and Lecturer on Anatomy to the Training

ELECTED

School for Nurses, at the Philadelphia General Hospital. Philadelphia General Hospital, Thirty-fourth and Pine Sts.

1893. FRIEBIS, GEORGE, M.D., Ophthalmic Surgeon to the Lutheran Home and Orphanage, Mt. Airy. 1906 Chestnut St.

1910. FURBUSH, CHARLES LINCOLN, M.D. 1501 Spruce St.

1889. FUSSELL, M. HOWARD, M.D., Assistant Professor of Medicine in the University of Pennsylvania; Physician to St. Timothy's Hospital; Physician to St. Mary's Hospital. 421 Lyceum Ave., Manayunk.

1899. GAMBLE, ROBERT G., M.D., one of the Attending Physicians to the Bryn Mawr Hospital. Haverford, Pa.

1873. GERHARD, GEORGE S., M.D., Physician-in-Chief to the Bryn Mawr Hospital; Consulting Physician to Bryn Mawr College; Consulting Physician to Villa Nova College. Fifty-eighth Street and Overbrook Ave.

1902. GHRISKEY, ALBERT A., M.D. 3936 Walnut St.

1892. GIBB, JOSEPH S., M.D., Professor of Diseases of the Throat and Nose in the Philadelphia Polyclinic; Surgeon to the Ear, Nose, and Throat Department of the Episcopal Hospital. 1907 Chestnut St.

1899. GIBBON, JOHN H., M.D., Professor of Surgery in the Jefferson Medical College; Surgeon to the Pennsylvania and the Bryn Mawr Hospitals; Consulting Surgeon to the Woman's Hospital. 1608 Spruce St.

1908. GILDERSLEEVE, NATHANIEL, M.D., Associate in Bacteriology in the University of Pennsylvania; Pathologist to the Bar Harbor Medical and Surgical Hospital, Bar Harbor, Me. Dormitories, University of Pennsylvania.

1897. GIRVIN, JOHN H., M.D., Physician for Diseases of Women at the Presbyterian Hospital; Instructor in Obstetrics in the University of Pennsylvania. 3924 Walnut St.

1889. GITHENS, WILLIAM H. H., M.D. 1327 Pine St.

1906. GITTINGS, J. CLAXTON, M.D., Instructor in Pediatrics in the University of Pennsylvania; Assistant Pediatric Physician to the University Hospital; Visiting Physician to the Children's Hospital, the Children's Department of the Mary J. Drexel Home, and to the Out-patient Department of the Presbyterian Hospital. 3942 Chestnut St.

1905. GIVEN, ELLIS E. W., M.D., Surgeon to the Dispensary of the Episcopal Hospital; Surgeon to the Dispensary of St. Christopher's Hospital for Children. 2714 Columbia Ave.

ELECTED

1894. Gleason, E. B., S.B., M.D., LL.D., Professor of Otology in the Medico-Chirurgical College. 2033 Chestnut St.

1906. Goepp, R. Max, M.D., Professor of Clinical Medicine in the Philadelphia Polyclinic and College for Graduates in Medicine; Assistant Visiting Physician to the Philadelphia General Hospital; Associate in Clinical Medicine in the Jefferson Medical College. 332 S. Fifteenth St.

1906. Goldberg, Harold G., M.D., Curator and Pathologist to the Wills Eye Hospital; First Lieutenant and Assistant Surgeon to the Second Troop, Philadelphia City Cavalry, N. G. P. 1905 Chestnut St.

1893. Goodell, W. Constantine, M.D. 300 S. Thirteenth St.

1908. Goodman, Edward H., M.D., Instructor in Medicine in the University of Pennsylvania; Assistant Physician to the Medical Dispensary of the University Hospital; Dispensary Physician to the Presbyterian Hospital. 248 S. Twenty-first St.

1905. Gordon, Alfred, M.D., Associate Member of the Société Médico-Psychologique, Paris; Neurologist to the Mt. Sinai, the Northwestern General, and the Douglass Memorial Hospitals. 1430 Pine St.

*†1897. Gould, George M., A.M., M.D. The Sentinels, Cayuga Heights, Ithaca, N. Y.

1894. Graham, Edwin E., M.D., Professor of Pediatrics in the Jefferson Medical College; Pediatrist to the Jefferson and the Philadelphia General Hospitals; Physician to the Franklin Reformatory Home. 1713 Spruce St.

1885. Graham, John, M.D. 326 S. Fifteenth St.

1904. Grayson, Charles P., M.D., Clinical Professor of Laryngology and Rhinology in the University of Pennsylvania; Physician-in-Charge of the Throat and Nose Department of the University Hospital; Otolaryngologist to the Philadelphia General Hospital. 1435 Spruce St.

1910. Greenman, Milton J., M.D., Director of the Wistar Institute of Anatomy and Biology. 3618 Woodland Ave.

1883. Griffith, J. P. Crozer, M.D., Clinical Professor of Diseases of Children in the University of Pennsylvania; Corresponding Member of the Société de Pédiatrie de Paris; Member of the American Pediatric Society and of the Association of American Physicians. 1810 Spruce St.

1902. Gwyn, Norman B., M.B., Instructor in Medicine in the University of Pennsylvania. 23 S. Twenty-first St.

ELECTED

1894. Hamill, Samuel McC., M.D., Professor of Diseases of Children in the Philadelphia Polyclinic and College for Graduates in Medicine; Pediatrist to the Presbyterian Hospital; Pediatrist to St. Vincent's Home. 1822 Spruce St.

1897. Hand, Alfred, Jr., M.D., Visiting Physician to the Children's Hospital, to the Children's Hospital of the Mary J. Drexel Home, and to the Methodist Hospital. 1724 Pine St.

1886. Hansell, Howard F., M.D., Professor of Ophthalmology in the Jefferson Medical College; Ophthalmic Surgeon to the Philadelphia General Hospital and to the Jefferson Medical College Hospital; Emeritus Professor of Diseases of the Eye in the Philadelphia Polyclinic. 1528 Walnut St.

1889. Hare, Hobart A., M.D., Professor of Therapeutics in the Jefferson Medical College; Physician to the Jefferson Medical College Hospital. 1801 Spruce St.

1903. Hart, Charles D., M.A., M.D., Physician to the Outpatient Department of the Pennsylvania Hospital; Inspector of the Eastern Penitentiary. 1317 Walnut St.

1885. Harte, Richard H., M.D., Adjunct Professor of Surgery in the University of Pennsylvania; Surgeon to the Pennsylvania and to the Orthopædic Hospitals; Consulting Surgeon to St. Mary's, St. Timothy's, and the Bryn Mawr Hospitals. 1503 Spruce St.

1888. Hartzell, Milton B., M.D., Associate in Dermatology in the University of Pennsylvania; Clinical Professor of Dermatology in the Woman's Medical College of Pennsylvania; Dermatologist to the Philadelphia General Hospital. 3644 Chestnut St.

1907. Hatfield, Charles James, A.B. (Princeton), M.D., Physician to the Henry Phipps Institute for the Study, Treatment, and Prevention of Tuberculosis; Visiting Physician to the White Haven Sanatorium. 2008 Walnut St.

1872. Hays, I. Minis, M.D. 266 S. Twenty-first St.

1882. Hearn, W. Joseph, M.D., Professor of Clinical Surgery in the Jefferson Medical College; Surgeon to the Philadelphia General Hospital. 1120 Walnut St.

1908. Heineberg, Alfred, M.D., Demonstrator of Gynecology in the Jefferson Medical College; Assistant Gynecologist to St. Agnes' Hospital; Instructor in Therapeutics and Materia Medica in the Jefferson Medical College, and in the Philadelphia College of Pharmacy. 1642 Pine St.

ELECTED

1901. Heisler, John C., M.D., Professor of Anatomy in the Medico-Chirurgical College. 3829 Walnut St.

1884. Henry, Frederick P., A.M., M.D., Professor of the Principles and Practice of Medicine in the Woman's Medical College of Pennsylvania; Physician to the Philadelphia General Hospital; Corresponding Member of the Royal Academy of Medicine of Rome. 114 S. Eighteenth St.

1903. Henry, J. Norman, M.D., Physician to the Pennsylvania Hospital; Clinical Professor of Medicine in the Woman's Medical College of Pennsylvania; Assistant Physician to the Philadelphia General Hospital. 1624 Spruce St.

1891. Hewson, Addinell, A.M., M.D., Professor of Anatomy in the Philadelphia Polyclinic and College for Graduates in Medicine; Surgeon to St. Timothy's Hospital, Roxborough. 2120 Spruce St.

1909. Higbee, William S., M.D., President of the Pennsylvania State Board of Examiners for Registration of Nurses. 1703 S. Broad St.

1910. Hill, Howard Kennedy, M.D., Assistant Instructor in Medicine in the University of Pennsylvania; Physician to the Children's Medical Dispensary of the Presbyterian Hospital; Visiting Physician to the University Settlement, and to the Day Nursery; Assistant Physician to the Medical Dispensary of the Children's Hospital. 1702 Locust St.

1897. Hinkle, William M., M.D., Lecturer on the Anatomy and Physiology of the Vocal Organs in the National School of Elocution and Oratory. 1323 N. Thirteenth St.

*1892. Hinsdale, Guy, A.M., M.D., Secretary of the American Climatological Association; Fellow of the Royal Society of Medicine, Great Britain; Fellow of the American Academy of Medicine; Lecturer on Climatology in the Medico-Chirurgical College, Philadelphia. Hot Springs, Virginia.

1888. Hirsh, A. Bern, M.D., Physician to the Home for Aged Couples. 1711 Diamond St.

1888. Hirst, Barton Cooke, M.D., Professor of Obstetrics in the University of Pennsylvania; Gynecologist to the Philadelphia General and the Howard Hospitals. 1821 Spruce Street.

1903. Hirst, John Cooke, M.D., Assistant Obstetrician to the University and the Philadelphia General Hospitals; At-

ELECTED

tending Physician to the Maternity Hospital and to the Gynecological Dispensary of the Howard Hospital; Consulting Obstetrician to the Southeastern Dispensary. 1618 Pine St.

1908. Hitchens, Arthur Parker, M.D., Special Lecturer in the Medico-Chirurgical College. Glenolden, Pa.

*1894. Hoch, William R., M.D. 1434 Glenarm St., Denver, Col.

1905. Hodge, Edward B., M.D., Surgeon to the Presbyterian and the Children's Hospitals; Surgeon to the Out-patient Department of the Pennsylvania Hospital; Surgeon to the Widener School. 346 S. Sixteenth St.

1885. Holland, James W., M.D., Professor of Medical Chemistry and Toxicology in the Jefferson Medical College. 2006 Chestnut St.

1906. Holloway, Thomas B., M.D., Instructor in Ophthalmology in the University of Pennsylvania; Assistant Ophthalmologist to the Orthopædic Hospital and Infirmary for Nervous Diseases; Ophthalmologist to the Pennsylvania Institution for the Instruction of the Blind; Consulting Ophthalmologist to the Henry Phipps Institute. 1819 Chestnut St.

1888. Horwitz, Orville, M.D., Professor of Genito-urinary Surgery in the Jefferson Medical College; Surgeon to the Jefferson Medical College Hospital, to St. Agnes' Hospital, and to the State Hospital for the Insane; Consulting Surgeon to the Jewish Hospital. 1721 Walnut St.

1908. Hoyt, Daniel M., M.D., Demonstrator of Pharmacology in the University of Pennsylvania; Assistant Visiting Physician to the Philadelphia General Hospital. 3604 Chestnut St.

1892. Hughes, William E., M.D., Visiting Physician to the Philadelphia General Hospital; Pathologist to the Presbyterian Hospital. 3945 Chestnut St.

1898. Hutchinson, James P., M.D., Surgeon to the Pennsylvania, the Methodist, the Children's, St. Timothy's, and the Bryn Mawr Hospitals; Adjunct Professor of Surgery in the University of Pennsylvania. 133 S. Twenty-second St.

1871. Ingham, James V., M.D. 1811 Walnut St.

*1885. Jackson, Edward, M.D., Professor of Ophthalmology in the University of Colorado; Emeritus Professor of Diseases of

ELECTED

the Eye in the Philadelphia Polyclinic; Ophthalmologist to the Denver City and County Hospital. Metropolitan Building, Denver, Col.

1906. Jacobs, Francis Brinton, B.S., M.D., Pediatrist to the Howard Hospital; Pediatrist to the American Hospital for Diseases of the Stomach; Visiting Physician to the Philadelphia Orphan Asylum; Assistant in the Laboratory of the Polyclinic Hospital. 2032 Chestnut St.

1898. Johnson, Russell H., A.B. (Princeton), M.D., Physician to the Pennsylvania Institution for the Deaf and Dumb. Chestnut Hill, Philadelphia.

1900. Jones, Charles James, A.M., M.D., Ophthalmic Surgeon to St. Joseph's Hospital; Ophthalmic Surgeon to the House of the Good Shepherd, Germantown; Consulting Ophthalmologist to St. Vincent's Home; Assistant Surgeon to the Wills Eye Hospital. 1009 N. Sixth St.

1900. Jopson, John H., M.D., Surgeon to the Children's, the Presbyterian, and the Bryn Mawr Hospitals, and to the Philadelphia Home for Incurables. 1824 Pine St.

1900. Judson, Charles F., A.B., M.D., Physician to St. Christopher's Hospital for Children, to the Southern Home for Destitute Children, and to the Sheltering Arms.

1902. Jump, Henry D., M.D., Instructor in Medicine in the University of Pennsylvania; Assistant Physician to the Medical Dispensary of the University Hospital. 4634 Chester Ave.

1886. Jurist, Louis, M.D. 916 N. Broad St.

1903. Kalteyer, Frederick J., M.D., Demonstrator of Clinical Medicine in the Jefferson Medical College; Chief of the Out-patient Department, Assistant Attending Physician and Hematologist to the Jefferson Medical College Hospital; Pathologist to the Philadelphia Lying-in-Charity. 1533 Pine St.

1904. Kane, Bayard, M.D. 1632 Walnut St.

1910. Karsner, Howard T., M.D., Demonstrator of Pathology in the University of Pennsylvania; Assistant Pathologist to the University and the Philadelphia General Hospitals. 1320 S. Broad St.

†1867. Keen, William W., M.D., LL.D. (Hon.), F.R.C.S. (Eng. and Edin.), Emeritus Professor of the Principles of Surgery and of Clinical Surgery in the Jefferson Medical College;

ELECTED

Membre Correspondant Étranger de la Société de Chirurgie de Paris; Honorary Member of the Société Belge de Chirurgie and of the Clinical Society of London; Ehrenmitglied der deutschen Gesellschaft für Chirurgie. 1729 Chestnut St.

1897. Kelly, Aloysius O. J., A.M., M.D., Assistant Professor of Medicine in the University of Pennsylvania; Professor of the Theory and Practice of Medicine in the University of Vermont; Professor of Pathology in the Woman's Medical College of Pennsylvania; Physician to St. Agnes' Hospital, and Pathologist to the German Hospital. 1911 Pine St.

*1887. Kelly, Howard A., A.B., M.D., LL.D. (Aberdeen, Wash. and Lee, and Univ. of Pa.), Professor of Gynecology in Johns Hopkins University and Gynecologist to the Johns Hopkins Hospital, Baltimore, Md.; Hon. Fellow of the Edinburgh Obstetrical Society, the Royal Academy of Medicine of Ireland, and of the Glasgow Obstetrical and Gynecological Society. 1406 Eutaw Place, Baltimore, Md.

1909. Kelly, James A., A.M., M.D., Surgeon to St. Mary's Hospital; Pathologist and Associate in Surgery in the Philadelphia Polyclinic and College for Graduates in Medicine. 1621 N. Seventeenth St.

1898. Kempton, Augustus F., M.D. 2118 Pine St.

1905. Kercher, Delno E., M.D. 1534 Pine St.

*1907. Kinyoun, Joseph J., M.D., Ph.D. (Georgetown), Professor of Pathology and Bacteriology in the George Washington University. 1423 Clifton St., Washington, D. C.

1910. Klaer, Fred Harlan, A.B., M.D., Instructor in Medicine in the University of Pennsylvania; Physician-in-Charge of the Medical Dispensary of the University Hospital; Consulting Physician to the Chester County Hospital, West Chester, Pa. 334 S. Sixteenth St.

1895. Kneass, Samuel S., M.D., Associate in the William Pepper Laboratory of Clinical Medicine in the University of Pennsylvania. 1510 Walnut St.

1908. Knipe, Jay C., M.D., Ophthalmologist to the Jewish Hospital; Assistant Ophthalmologist to the Philadelphia General Hospital, and to the Mary J. Drexel Home; Chief of the Eye Clinic at the Jefferson Medical College Hospital; Demonstrator of Osteology and Syndesmology in the Jefferson Medical College. 2035 Chestnut St.

ELECTED

1808. Knowles, Frank Crozer, M.D., Assistant Dermatologist to the Philadelphia General Hospital; Dermatologist to the Northern Dispensary, the Church Home for Children, and St. Vincent's Home; Assistant Dermatologist to the Hospital of the Woman's Medical College, and to the Dispensary of the Children's Hospital; Associate Dermatologist to the Dispensary of the Howard Hospital. 332 South Seventeenth St.

1904. Krauss, Frederick, M.D., Ophthalmic and Aural Surgeon to St. Christopher's Hospital for Children and Dispensary; Chief of Eye Clinic at the Howard Hospital. 1701 Chestnut St.

1905. Kremer, Walter H., M.D. 6122 Main St., Germantown.

1900. Krusen, Wilmer, M.D., Professor of Gynecology in the Medical Department of Temple University; Chief Gynecologist to the Samaritan and the Garretson Hospitals; Consulting Gynecologist to the Charity and Mercy Hospitals. 127 N. Twentieth St.

1897. Kyle, D. Braden, A.M., M.D., Professor of Laryngology in the Jefferson Medical College; Consulting Laryngologist, Rhinologist, and Otologist to St. Agnes' Hospital and to the Philadelphia Home for Incurables; Laryngologist to the New Jersey Training School for Feeble-minded Children; Bacteriologist to the Orthopædic Hospital and Infirmary for Nervous Diseases. 1517 Walnut St.

1909. Laird, J. Packard, M.D., Visiting Physician to the Devon Branch of the Presbyterian Hospital of Philadelphia. Devon, Pa.

1904. Landis, Henry R. M., M.D., Visiting Physician to the White Haven Sanatorium; Member of the Staff of the Henry Phipps Institute; Assistant Visiting Physician to the Philadelphia Hospital. 11 S. Twenty-first St.

1907. Langdon, H. Maxwell, M.D., Instructor in Ophthalmology in the University of Pennsylvania; Assistant Surgeon to the Dispensary for Diseases of the Eye in the University Hospital; Assistant Ophthalmologist to the Orthopædic Hospital; Ophthalmologist to the Methodist Episcopal Home for the Aged. 1728 Chestnut St.

1908. Lavenson, Ralph S., M.D., Assistant Physician to the Philadelphia General Hospital; Assistant Pathologist to the University Hospital; Associate in the William Pepper

ELECTED

Laboratory of Clinical Medicine; Assistant Demonstrator of Gross Morbid Anatomy in the University of Pennsylvania. 1218 Locust St.

1904. Le Boutillier, Theodore, M.D., Clinical Professor of Pediatrics in the Woman's Medical College of Pennsylvania; Physician to the Dispensary of St. Christopher's Hospital for Children; Pediatrist to the Woman's College Hospital Dispensary; Visiting Physician to the Baptist Orphanage and to the Southern Home for Destitute Children. 216 S. Twentieth St.

1893. Le Conte, Robert G., A.B., M.D., Surgeon to the Pennsylvania and the Bryn Mawr Hospitals; Consulting Surgeon to the Germantown and the Gynecean Hospitals. 1530 Locust St.

1909. L'Engle, Edward M., M.D. Merion, Pa.

1887. Leaman, Henry, M.D. 832 N. Broad St.

1908. Lee, Walter E., M.D. 905 Pine St.

1903. Leffmann, Henry, A.M., M.D., D.D.S., Ph.D., Professor of Chemistry in the Woman's Medical College of Pennsylvania; Honorary Professor of Chemistry in the Wagner Free Institute of Science; Pathological Chemist to the Jefferson Medical College Hospital; Formerly Port Physician of Philadelphia. 1839 N. Seventeenth St.

1892. Leidy, Joseph, M.D., Officier l'instruction publique, France; Consulting Physician to the Pennsylvania Training School for Feeble-minded Children. 1319 Locust St.

1903. Leonard, Charles Lester, M.D. 112 S. Twentieth St.

1877. Lewis, Morris J., M.D., Physician to the Orthopædic Hospital and Infirmary for Nervous Diseases and to the Pennsylvania Hospital. 1316 Locust St.

1904. Lindauer, Eugene, M.D., Instructor of Neurology in the Medico-Chirurgical Hospital; Associate in Clinical Medicine in the Philadelphia Polyclinic; Assistant Neurologist to the Philadelphia General Hospital. 2018 N. Thirty-second St.

1886. Lloyd, J. Hendrie, A.M. (Princeton), M.D., Neurologist to the Philadelphia General Hospital; Physician to the Methodist Episcopal Hospital, and to the Home for Crippled Children; Consulting Neurologist to the State Asylum for the Chronic Insane of Pennsylvania and to the Pennsylvania Training School for Feeble-minded Children. 3918 Walnut St.

ELECTED

1900. Lodge, John W., M.D., Consulting Physician to the Bryn Mawr Hospital. Merion, Pa.

1907. Lodholz, Edward, M.D., Demonstrator of Physiology in the University of Pennsylvania. 3103 Diamond St.

1893. Longaker, Daniel, M.D., Surgeon to the Jewish Maternity Hospital. 1402 N. Sixteenth St.

1906. Longcope, Warfield T., M.D., Director of the Ayer Clinical Laboratory of the Pennsylvania Hospital; Instructor in Medicine in the University of Pennsylvania. 342 S. Fifteenth St.

1877. Longstreth, Morris, M.D. 1416 Spruce St.

1907. Loux, Hiram R., M.D. 1614 N. Broad St.

1900. McCarthy, Daniel J., M.D., Professor of Medical Jurisprudence (George B. Wood Foundation) in the University of Pennsylvania; Neurologist to the Philadelphia General and St. Agnes' Hospitals, and to the Henry Phipps Institute. 1329 Spruce St.

1875. McClellan, George, M.D., Professor of Applied Anatomy in the Jefferson Medical College; Consulting Surgeon to the Howard Hospital. 1116 Spruce St.

1903. McConnell, Guthrie, M.D., Professor of Pathology and Bacteriology in the Medical Department of Temple University; Pathologist to the Samaritan Hospital. Temple Medical School, Eighteenth and Buttonwood Sts.

1895. McFarland, Joseph, M.D., Professor of Pathology and Bacteriology in the Medico-Chirurgical College; Pathologist to the Medico-Chirurgical and to the Philadelphia General Hospital. 442 W. Stafford St., Germantown.

1905. McKenzie, Robert Tait, A.B., M.D., Professor of Physical Education and Director of the Department of Physical Education in the University of Pennsylvania. 26 S. Twenty-first St.

*1900. McReynolds, Robert Phillips, M.D. 213 S. Broadway, Los Angeles, Cal.

1886. MacCoy, Alexander W., M.D., Surgeon for Diseases of the Nose and Throat in the Out-patient Department of the Pennsylvania Hospital; Member of the American Laryngological Society. 216 S. Fifteenth St.

1901. MacLeod, George I., Jr., M.D., Physician to the Bryn Mawr Hospital; Assistant Physician to Bryn Mawr College. Ardmore, Pa.

ELECTED

1910. MacKinney, William H., M.D., Assistant Surgeon to the Dispensary for Genito-urinary Diseases, University Hospital; Assistant in the Urological Dispensary of the German Hospital. 1831 Chestnut St.

1896. Makuen, G. Hudson, M.D., Professor of Defects of Speech in the Philadelphia Polyclinic; Laryngologist to St. Mary's Hospital and to the Frederick Douglass Memorial Hospital; Visiting Consultant on Defects of Speech to the New Jersey Training School for Feeble-minded Children. 1627 Walnut St.

1898. Marshall, George Morley, M.D., Laryngologist to the Philadelphia General Hospital; Physician and Laryngologist to St. Joseph's Hospital. 1819 Spruce St.

1893. Marshall, John, M.D., Nat.Sc.D. (Tübingen), LL.D. 1718 Pine St.

1889. Martin, Edward, M.D., Professor of Clinical Surgery in the University of Pennsylvania; Surgeon to the University, Howard, Philadelphia General, and Bryn Mawr Hospitals. 1506 Locust St.

1885. Mays, Thomas J., M.D., Visiting Physician to the Rush Hospital. 1829 Spruce St.

*1868. Mears, J. Ewing, A.B., A.M., M.D., LL.D. 1535 Land Title Building, Broad and Sansom Sts.

1875. Meigs, Arthur V., M.D., Physician to the Pennsylvania Hospital; Consulting Physician to the Pennsylvania Institution for the Instruction of the Blind. 1322 Walnut St.

*1894. Miller, D. J. Milton, M.D., Associate Physician to the Children's Hospital. 127 S. Illinois Ave., Atlantic City, N.J.

1910 Miller, Morris Booth, M.D., Professor of Surgery in the Philadelphia Polyclinic; Surgeon to the Douglass Memorial Hospital; Assistant Surgeon to the Philadelphia General Hospital. 2117 Pine St.

1881. Mills, Charles K., M.D., Professor of Neurology in the University of Pennsylvania; Neurologist to the Philadelphia General Hospital; Consultant to the Orthopædic Hospital and Infirmary for Nervous Diseases. 1909 Chestnut St.

1904. Mitchell, Charles F., M.D., Surgeon to the Germantown Hospital and to the Out-patient Department of the Pennsylvania Hospital; Assistant Surgeon to the Orthopædic Hospital and Infirmary for Nervous Diseases. 1503 Spruce St.

ELECTED

†1888. Mitchell, John K., M.D., Assistant Physician to the Orthopædic Hospital and Infirmary for Nervous Diseases; Assistant Neurologist to the Presbyterian Hospital; Attending Physician to the Pennsylvania Training School for Feeble-minded Children. 1730 Spruce St.

1856. Mitchell, Silas Weir, M.A., M.D., LL.D. (Edinburgh, Harvard, Princeton, and Toronto), Corresponding Member of the French Academy of Medicine; Corresponding Member of the Verein für innerer Medicin, Berlin; Honorary Member of the Royal Medico-Chirurgical Society of London; Doctor of Medicine, Honoris Causa, University of Bologna. 1524 Walnut St.

1908. Montgomery, Charles M., A.B., M.D., Physician to the Dispensary and Instructor in the Henry Phipps Institute (University of Pennsylvania); Physician to the Home for Consumptives at Chestnut Hill. 905 Pine St.

1882. Montgomery, Edward E., A.M., M.D., LL.D., Professor of Gynecology in the Jefferson Medical College; Gynecologist to the Jefferson Medical College Hospital and to St. Joseph's Hospital. 1703 Walnut St.

1886. Morris, Caspar, M.D. 2050 Locust St.

1893. Morris, Elliston J., M.D., Physician to the Episcopal Hospital and to the Midnight Mission. 128 S. Eighteenth St.

1883. Morris, Henry, M.D., Professor of Anatomy in the Woman's Medical College of Pennsylvania; Senior Visiting Physician to St. Joseph's Hospital; Associate Member, Military Surgeons of U. S. A. 313 S. Sixteenth St.

1856. Morris, J. Cheston, M.D. 1514 Spruce St.

1906. Morrison, William H., M.D. 8021 Frankford Ave.

1897. Morton, Samuel W., M.D. 1933 Chestnut St.

1904. Moulton, Albert R., M.D., Senior Assistant Physician to the Pennsylvania Hospital for the Insane; Physician to the Out-patient Department for Nervous and Mental Diseases at the Pennsylvania Hospital; Professor of Mental Diseases in the Maine Medical School (Bowdoin College). Pennsylvania Hospital for the Insane.

1905. Müller, George P., M.D., Associate in Surgery in the University of Pennsylvania; Assistant Surgeon to the University and the Philadelphia General Hospitals; Surgeon to St. Christopher's Hospital for Children; Consulting Surgeon to the Chester County Hospital. 334 S. Fifteenth St.

ELECTED

1882. Musser, John H., M.D., LL.D., Professor of Clinical Medicine in the University of Pennsylvania; Physician to the University, the Philadelphia General, and the Presbyterian Hospitals. 1927 Chestnut St.

1905. Mutschler, Louis H., M.D., Surgeon to the Episcopal Hospital; Surgeon to the Dispensary of St. Christopher's Hospital for Children; Assistant Surgeon to the Orthopædic Hospital. 2030 Tioga St.

1896. Myers, T. D., M.D. 1521 Spruce St.

1902. Nassau, Charles F., M.D., Assistant Professor of Surgery in the Jefferson Medical College; Surgeon to St. Joseph's Hospital; Consulting Surgeon to the Frankford Hospital; Assistant Surgeon to the Jefferson Medical College Hospital. 1831 Chestnut St.

1886. Neff, Joseph S., M.D. 580 City Hall.

1887. Neilson, Thomas Rundle, A.M., M.D., Surgeon to the Episcopal Hospital and to St. Christopher's Hospital for Children; Clinical Professor of Genito-urinary Diseases in the University of Pennsylvania. 122 S. Seventeenth St.

1905. Newcomet, William S., M.D. 3501 Baring St.

1905. Newlin, Arthur, B.S., M.D., Physician to the Dispensaries of the Pennsylvania Hospital and of the Children's Hospital; Assistant Physician to the Orthopædic Hospital; Associate in Pediatrics in the Philadelphia Polyclinic. 1804 Pine St.

1899. Nicholson, William R., Jr., M.D., Assistant Instructor in Obstetrics in the University of Pennsylvania; Obstetrician to the Maternity Hospital; Assistant Surgeon to the Gynecean Hospital. 322 S. Fifteenth St.

1889. Noble, Charles P., M.D., Surgeon-in-Charge of the Department for Women of the Northern Dispensary and of the Union Mission Hospital; Clinical Professor of Gynecology in the Woman's Medical College of Pennsylvania; Lecturer on Gynecology in the Philadelphia Polyclinic. 1509 Locust St

1898. Nolan, Edward J., M.D., Recording Secretary and Librarian of the Academy of Natural Sciences of Philadelphia. 825 N. Twentieth St.

1905. Norris, Charles C., M.D., Instructor in Gynecology in the University of Pennsylvania; Obstetrician and Assistant Attending Physician to the Maternity Hospital; Gynecologist to the Philadelphia General Hospital. 1503 Locust St.

ELECTED

1905. Norris, George William, A.B., M.D., Associate in Medicine in the University of Pennsylvania; Assistant Physician to the Philadelphia General and the University Hospitals; Physician to the Medical Out-patient Department of the Pennsylvania Hospital. 1530 Locust St.

*1901. Norris, Henry, M.D. Rutherfordton, N. C.

*1865. Norris, Isaac, M.D. Fairhill, Bryn Mawr, Pa.

1892. Norris, Richard C., M.D., Lecturer on Clinical and Operative Obstetrics in the University of Pennsylvania; Obstetrician in Charge of the Preston Retreat; Visiting Obstetrician to the Philadelphia General Hospital; Gynecologist to the Methodist Episcopal Hospital, and Consulting Obstetrician and Attending Gynecologist to the Southeastern Dispensary and Hospital. 500 N. Twentieth St.

1884. Oliver, Charles A., A.M., M.D., Surgeon to the Wills Eye Hospital; Ophthalmic Surgeon to the Philadelphia General and the Presbyterian Hospitals; Consulting Ophthalmic Surgeon to St. Agnes' Hospital. 1507 Locust St.

*1884. O'Neill, J. Wilks, M.D. Bergenfield, N. J.

*1885. Osler, William, M.D., Regius Professor of Medicine in Oxford University, England. No. 7, Norham Gardens, Oxford, England.

1903. Ostheimer, Maurice, M.D., Associate in Pediatrics in the University of Pennsylvania; Physician-in-Charge of the Children's Dispensary and Assistant Visiting Pediatric Physician, University Hospital; Physician to the Medical Dispensary of the Children's Hospital; Physician to the Austro-Hungarian Consulate, Philadelphia. 118 South Twenty-second St.

1897. Packard, Francis R., M.D., Surgeon to the Ear, Nose, and Throat Clinic of the Pennsylvania Hospital; Professor of Diseases of the Nose and Throat in the Philadelphia Polyclinic and College for Graduates in Medicine; Laryngologist to the Children's Hospital of Philadelphia; Consulting Aurist to the Bryn Mawr Hospital. 304 S. Nineteenth St.

1898. Page, Henry F., M.D., Assistant Physician to the German Hospital and Physician to the Medical Dispensary of the same; Instructor in Clinical Medicine in the Woman's Medical College of Pennsylvania; Physician to the Baptist Home. 1907 Girard Ave.

ELECTED

1906. Pancoast, Henry K., M.D., Lecturer on Skiagraphy in the University of Pennsylvania; Skiagrapher to the University Hospital. 4238 Pine St.

1909. Parish, Benjamin D., B.S., M.D., Assistant Instructor in Otology in the University of Pennsylvania; Assistant Surgeon to the Dispensary for Diseases of the Ear, University Hospital; Aurist and Laryngologist to St. Agnes' Hospital. 29 S. Nineteenth St.

1899. Parke, William E., M.D., Consulting Obstetrician to the Episcopal Hospital; Associate Surgeon to the Kensington Hospital for Women; Gynecologist to the Frankford Hospital. 1739 N. Seventeenth St.

1910. Patterson, Ross Vernet, M.D., Associate in Medicine and Sub-Dean in the Jefferson Medical College. 340 S. Sixteenth St.

1903. Pearce, Richard M., M.D. 2114 De Lancey Place.

1909. Pemberton, Ralph, B.S., M.S., M.D., Woodward Fellow in Physiological Chemistry in the William Pepper Laboratory of Clinical Medicine in the University of Pennsylvania; Assistant Instructor in Medicine in the University of Pennsylvania; Physician to the Out-patient Department of the Presbyterian Hospital. 1947 Locust St.

†1889. Penrose, Charles Bingham, M.D., Ph.D. (Harvard), Formerly Professor of Gynecology in the University of Pennsylvania. 1720 Spruce St.

†1902. Pepper, William, M.D., Instructor in Medicine in the University of Pennsylvania. 1811 Spruce St.

1884. Perkins, Francis M., M.D. 1428 Pine St.

1905. Pfahler, George E., M.D., Director of the Röntgen Ray Laboratory of the Medico-Chirurgical Hospital. 1321 Spruce St.

1907. Pfromm, George W., Ph.G., M.D. 1434 N. Fifteenth St.

1907. Phillips, Horace, M.D., Second Assistant Physician to the Pennsylvania Hospital for the Insane; Visiting Physician to the Eastern Penitentiary of Pennsylvania. Pennsylvania Hospital for the Insane.

1883. Piersol, George A., M.D., Professor of Anatomy in the University of Pennsylvania. 4722 Chester Ave.

1905. Pitfield, Robert L., M.D., Pathologist to the Germantown Hospital; Bacteriologist to the Chestnut Hill Hospital for Lung Diseases. 5211 Wayne Ave.

ELECTED

1896. Posey, William Campbell, M.D., Surgeon to the Wills Eye Hospital; Professor of Ophthalmology in the Philadelphia Polyclinic and College for Graduates in Medicine; Ophthalmic Surgeon to the Howard Hospital; Ophthalmologist to the Pennsylvania Hospital for Epileptics. 2049 Chestnut St.

1899. Potts, Charles S., M.D., Professor of Neurology in the Medico-Chirurgical College; Neurologist to the Philadelphia General Hospital; Consultant to the Insane Department of the Philadelphia General Hospital; Consultant to the Hospital for the Insane, Atlantic County, New Jersey. 1728 Chestnut St.

1905. Prendergast, Michael T., M.D. 2023 Columbia Ave.

1907. Price, George E., M.D., Assistant Professor of Nervous and Mental Diseases in the Jefferson Medical College; Assistant Neurologist to the Philadelphia General Hospital. 1700 Walnut St.

†1889. Price, Joseph, M.D., Obstetric Physician to the Philadelphia Dispensary. 241 N. Eighteenth St.

1903. Purves, George Morehouse, M.D., Registrar of the Surgical Dispensary of the Hospital of the University of Pennsylvania. 4204 Walnut St.

†1903. Pyle, Walter L., A.M., M.D., Member of the American Ophthalmological Society; Assistant Surgeon to the Wills Eye Hospital. 1931 Chestnut St.

1908. Radcliffe, McCluney, A.M. (Lafayette), M.D., Attending Surgeon to the Wills Eye Hospital. 1812 Chestnut St.

1887. Randall, B. Alexander, M.A., M.D., Clinical Professor of Diseases of the Ear in the University of Pennsylvania; Ear Surgeon to the Children's Hospital; Consulting Aurist to the Pennsylvania Institution for the Deaf and Dumb, and to St. Timothy's Hospital. 1717 Locust St.

*1904 Ravenel, Mazyck P., M.D., Professor of Bacteriology in the University of Wisconsin. Madison, Wis.

1887. Reed, Charles H., M.D. 121 S. Seventeenth St.

1885. Reichert, Edward T., M.D., Professor of Physiology in the University of Pennsylvania. University of Pennsylvania.

1897. Rhein, John H. W., M.D., Neurologist to the Howard Hospital; Physician to the Philadelphia Home for Incurables; Bacteriologist to the Pennsylvania Training School for

ELECTED

Feeble-minded Children; Member of the American Neurological Association. 1732 Pine St.

1906. Rhein, Robert D., M.D., Chief Physician to the Clinic of the American Hospital for Diseases of the Stomach Assistant Physician to the Medical Dispensary of the Children's Hospital; Examining Physician to the White Haven Sanatorium. 2016 Pine St.

1891. Rhoads, Edward G., M.D. 159 W. Coulter St., Germantown.

1910. Rhoads, Samuel, M.D., Visiting Physician to the Tuberculosis Department of the Philadelphia General Hospital; Consulting Physician to the Home for Consumptives, Chestnut Hill; Physician to the Medical Dispensary of St. Christopher's Hospital for Children; Visiting Physician to the Tuberculosis Department, City Farm, Byberry, Pa. 152 Schoolhouse Lane, Germantown.

1898. Riesman, David, M.D., Professor of Clinical Medicine in the Philadelphia Polyclinic; Assistant Professor of Medicine in the University of Pennsylvania; Physician to the Philadelphia General and the Jewish Hospitals. 1715 Spruce St.

1895. Ring, G. Oram, A.M., M.D., Ophthalmic Surgeon to the Episcopal Hospital; Ophthalmologist to the Widener Memorial Home for Crippled Children; Consulting Ophthalmologist to the American Oncologic Hospital. 2014 Chestnut St.

1905. Risley, J. Norman, M.D., Assistant Surgeon to the Wills Eye Hospital; Ophthalmologist to the Pennsylvania Training School for Feeble-minded Children. 1728 Chestnut St.

1891. Risley, S. D., M.D., Attending Surgeon to the Wills Eye Hospital; Professor (Emeritus) of Ophthalmology in the Philadelphia Polyclinic and College for Graduates in Medicine; Member of the Board of Managers of the Pennsylvania Training School for Feeble-minded Children; Alumnus Manager of the University Hospital. 1728 Chestnut St.

†1878. Roberts, John B., M.D., Professor of Surgery in the Philadelphia Polyclinic; Surgeon to the Methodist Episcopal Hospital. 313 S. Seventeenth St.

1899. Roberts, Walter, M.D., Professor of Otology in the Philadelphia Polyclinic; Otologist to the Methodist Episcopal Hospital; Laryngologist to the Philadelphia General Hospital. 1732 Spruce St.

ELECTED

1903. Robertson, William Egbert, M.D., Professor of Theory and Practice of Medicine and of Clinical Medicine in Temple University; Physician to the Episcopal, Samaritan, and Garretson Hospitals. 320 S. Sixteenth St.

1907. Robinson, Edwin Taylor, M.D. 1906 Pine St.

1910. Robinson, G. Canby, M.D., Chief Resident Physician at the Hospital of the Rockefeller Institute. Hospital of the Rockefeller Institute, Sixty-sixth Street and Avenue A, New York.

1902. Robinson, James Weir, M.D., Assistant Surgeon to the Presbyterian Hospital. 326 S. Sixteenth St.

1903. Robinson, William Duffield, Ph.G., M.D. 2012 Mount Vernon St.

1900. Rodman, William L., M.D., Professor of Surgery in the Medico-Chirurgical College; Surgeon to the Presbyterian Hospital; Surgeon to the Philadelphia General Hospital. 1904 Chestnut St.

1909. Rosenberger, Randle C., M.D., Professor of Hygiene and Bacteriology in the Jefferson Medical College; Director of the Clinical Laboratory of the Philadelphia General Hospital; Lecturer on Hygiene in the Woman's Medical College of Pennsylvania; Bacteriologist to the Jefferson Medical College Hospital. 2330 N. Thirteenth St.

1898. Ross, George G., M.D., Assistant Surgeon to the German Hospital and Surgeon to the Out-patient Department of the same; Surgeon to the Germantown Hospital. 1721 Spruce St.

*1907. Royer, B. Franklin, M.D. Donaldson Building, Harrisburg, Pa.

†1905. Rugh, James Torrance, M.D., Orthopedic Surgeon to the Methodist Hospital; Demonstrator of Orthopedic Surgery in the Jefferson Medical College; Assistant Orthopedist to the Jefferson Hospital; Assistant Orthopedist to the Philadelphia General Hospital. 1616 Spruce St.

1897. Sailer, Joseph, Ph.B., M.D., Assistant Professor of Clinical Medicine in the University of Pennsylvania; Physician to the Presbyterian and the Philadelphia General Hospitals; Pathologist to the Pennsylvania Training School for Feeble-minded Children. 1830 Spruce St.

1900. Sajous, Charles E. de M., M.D., B.Lett., LL.D., Knight of the Legion of Honor, and Officer of the Academy of

ELECTED

France; Corresponding Member of the Society of Public Medicine of Belgium; Member of Honor of the French Society of Hygiene, etc. 2043 Walnut St.

1910. Saladé, Louis A., M.D., Gynecologist to the Methodist Episcopal Hospital. 1827 Spruce St.

1905. Sartain, Paul J., M.D. 212 W. Logan Square.

1908. Sautter, Albert C., M.D., Assistant in the Dispensary for Diseases of the Eye in the University Hospital; Assistant in the Eye Dispensary of the German Hospital. 1421 Locust St.

1906. Saylor, Edwin S., M.D., Ophthalmologist to St. Timothy's Hospital, Roxborough. 2005 Chestnut St.

1910. Scarlet, Rufus B., M.D., Laryngologist to the Home for Consumptives at Chestnut Hill; Assistant in the Department for Diseases of the Nose, Throat, and Ear of the Pennsylvania Hospital; Instructor in Diseases of the Nose and Throat in the Philadelphia Polyclinic and College for Graduates in Medicine. 4009 Chestnut St.

1899. Schamberg, Jay F., M.D., Professor of Dermatology and Infectious Eruptive Diseases in the Philadelphia Polyclinic and College for Graduates in Medicine; Assistant Physician to the Municipal Hospital for Infectious Diseases. 1922 Spruce St.

1907. Schwartz, George J., M.D., Assistant Surgeon to the Philadelphia General Hospital; Instructor in Surgery in Jefferson Medical College. 1606 S. Broad St.

1887. Schweinitz, George E. de, M.D., Professor of Ophthalmology in the University of Pennsylvania; Ophthalmic Surgeon to the Philadelphia General Hospital; Consulting Ophthalmic Surgeon to the Philadelphia Polyclinic; Ophthalmologist to the Orthopædic Hospital and Infirmary for Nervous Diseases. 1705 Walnut St.

1910. Schwenk, Peter N. K., M.A., M.D., Attending Surgeon to the Eye Department of the Pennsylvania Hospital; Attending Surgeon to the Wills Eye Hospital. 810 N. Seventh St.

1892. Seiss, Ralph W., M.D., Professor of Otology in the Philadelphia Polyclinic; Consulting Laryngologist to the Pennsylvania Institution for the Deaf and Dumb. 255 S. Seventeenth St.

1908. Shannon, Charles E. G., A.B., M.D., Instructor in Ophthalmology in the Jefferson Medical College; Assistant in

ELECTED

the Ophthalmological Clinic at the Jefferson Medical College Hospital; Ophthalmologist to the Seybert Institution. 1633 Spruce St.

1897. Sharpless, William T., M.D., Physician to the Chester County Hospital. West Chester, Pa.

1906. Shields, William G., M.D., Chief of Dermatological Clinic and Assistant Physician to the Jewish Hospital. 412 Schoolhouse Lane, Germantown.

1876. Shippen, Edward, A.M. (Princeton), M.D., Rear Admiral on the Retired List, U. S. Navy. 2039 Pine St.

1891. Shober, John B., A.M., M.D., Associate Gynecologist to the Gynecean Hospital; Gynecologist to the Howard Hospital; Obstetrician to the Philadelphia General Hospital. 1731 Pine St.

1890. Shoemaker, George Erety, A.M., M.D., Gynecologist to the Presbyterian Hospital and to the Pennsylvania Epileptic Hospital and Colony Farm; Consulting Surgeon to the Woman's Hospital of Philadelphia. 1831 Chestnut St.

*1908. Shoemaker, Harlan, A.B. (Stanford), M.D. Shelby, N. C.

†1893. Shoemaker, Harvey, M.D., Visiting Physician to the Sheltering Arms and to the Southern Home for Destitute Children; Assistant Physician to the German Hospital; Physician to the Out-patient Department of the German and the Pennsylvania Hospitals. 2011 Chestnut St.

†1896. Shoemaker, William T., M.D., Ophthalmic Surgeon to the Germantown Hospital; Assistant Ophthalmologist and a Chief of Clinic to the German Hospital; Dispensary Ophthalmic Surgeon to the Presbyterian Hospital; Consulting Ophthalmologist to the Pennsylvania Institution for the Deaf and Dumb. 109 S. Twentieth St.

1900. Shumway, Edward Adams, B.S., M.D., Instructor in Ophthalmology in the University of Pennsylvania, and Assistant Ophthalmic Surgeon to the University Hospital; Assistant Ophthalmologist to the Philadelphia General Hospital; Assistant Ophthalmologist and a Chief of Clinic to the German Hospital. 2007 Chestnut St.

1903. Sinclair, John Falconer, M.D., Physician to the Medical Dispensary of the Presbyterian Hospital; Physician to the Philadelphia Orphan Asylum and to the Presbyterian Orphanage; Physician to the Home of the Merciful Saviour for Crippled Children. 4103 Walnut St.

ELECTED

1907. Sinkler, Francis Wharton, A.B., M.D., Physician to the Orthopædic Hospital and Infirmary for Nervous Diseases; Physician to the Episcopal Hospital. 1606 Walnut St.

1902. Siter, E. Hollingsworth, M.D., Instructor in Genito-urinary Diseases in the University of Pennsylvania; Genito-urinary Surgeon to the Philadelphia General Hospital; Surgeon-in-Charge of the Genito-urinary Dispensary of the University Hospital; Surgeon to the Dispensary of the Children's Hospital. 2038 Locust St.

1904. Skillern, Penn-Gaskell, M.D. 241 S. Thirteenth St.

1904. Smith, Allen J., A.M., M.D., Sc.D., Professor of Comparative Pathology, and in charge of the Courses in Tropical Medicine in the University of Pennsylvania; Pathologist to the University Hospital, to the Philadelphia General Hospital, and to the State Hospital for the Insane at Norristown, Pa. University of Pennsylvania.

1905. Smith, S. MacCuen, M.D., Professor of Otology in the Jefferson Medical College; Aurist and Laryngologist to the Germantown Hospital; Aurist to the Jewish Hospital; Consulting Aurist to the Oncologic Hospital. 1429 Spruce St.

1908. Speese, John, M.D., Instructor in Surgery in the University of Pennsylvania; Surgeon to the Dispensary of the Presbyterian, the Children's, and the Polyclinic Hospitals. 248 S. Twenty-first St.

1895. Spellissy, Joseph M., A.M., M.D., Surgeon to the Outpatient Department of the Pennsylvania Hospital; Visiting Surgeon to St. Joseph's and to the Methodist Episcopal Hospitals; Assistant Surgeon to the Orthopedic Department of the University Hospital. 110 S. Eighteenth St.

1897. Spiller, William G., M.D., Associate Professor of Neurology and Professor of Neuropathology in the University of Pennsylvania; Clinical Professor of Nervous Diseases in the Woman's Medical College of Pennsylvania; Professor of Nervous Diseases in the Philadelphia Polyclinic and College for Graduates in Medicine. 4409 Pine St.

1908. Spitzka, Edward Anthony, M.D., Professor of General Anatomy in the Jefferson Medical College. Jefferson Medical College.

1894. Stahl, B. Franklin, B.S., Ph.G., M.D., Clinical Professor of Medicine in the Woman's Medical College of Pennsylvania; Lecturer on Dietetics of the Sick in the University

ELECTED

of Pennsylvania; Visiting Physician to St. Agnes' Hospital; Visiting Physician to the Philadelphia General Hospital. 1727 Pine St.

1909. STARBUCK, J. CLINTON, M.D. 42 E. Washington St., Media, Pa.

1875. STARR, LOUIS, M.D., LL.D. (Haverford). 1818 S. Rittenhouse Square.

1892. STEINBACH, LEWIS W., M.D., Professor of Clinical and Operative Surgery in the Philadelphia Polyclinic; Visiting Surgeon to the Philadelphia General and the Jewish Hospitals. 1309 N. Broad St.

1910. STELLWAGEN, THOMAS C., JR., M.D., Chief Clinical Assistant in the Out-patient Surgical Department of the Jefferson Medical College Hospital. 1119 Spruce St.

1884. STELWAGON, HENRY W., M.D., Ph.D., Professor of Dermatology in the Jefferson Medical College; Dermatologist to the Philadelphia General and the Howard Hospitals. 1634 Spruce St.

1895. STENGEL, ALFRED, M.D., Professor of Clinical Medicine in the University of Pennsylvania; Physician to the University, the Pennsylvania, and the Philadelphia General Hospitals. 1811 Spruce St.

1901. STEVENS, ARTHUR A., M.D., Professor of Materia Medica, Therapeutics, and Clinical Medicine in the Woman's Medical College of Pennsylvania; Lecturer on Physical Diagnosis in the University of Pennsylvania; Physician to the Episcopal and St. Agnes' Hospitals. 314 S. Sixteenth St.

1902. STEWART, FRANCIS T., M.D., Professor of Clinical Surgery in the Jefferson Medical College; Surgeon to the Germantown Hospital; Surgeon to the Out-patient Department of the Pennsylvania Hospital. 311 S. Twelfth St.

1898. STOUT, GEORGE C., M.D., Professor of Otology in the Philadelphia Polyclinic and College for Graduates in Medicine; Laryngologist and Aurist to the Presbyterian Hospital, the Children's Aid Society, and the William Penn Charter School. 1611 Walnut St.

1884. STRYKER, SAMUEL S., M.D., Physician to the Presbyterian Hospital. 3833 Walnut St.

*1900. SWAN, JOHN M., M.D., Medical Director of the Glen Springs, Watkins Glen, New York; Secretary of the American Society of Tropical Medicine. Glen Springs, Watkins Glen, N. Y.

ELECTED

1898. Sweet, William M., M.D., Professor of Diseases of the Eye in the Philadelphia Polyclinic; Associate Professor of Ophthalmology in the Jefferson Medical College; Assistant Ophthalmic Surgeon to the Philadelphia General Hospital; Consulting Ophthalmologist to the Phœnixville Hospital. 1205 Spruce St.

1906. Tait, Thomas W., M.D., Ophthalmologist to the Charity Hospital. 320 S. Fifteenth St.

1900. Talley, James Ely, A.B., M.D., Physician to the Presbyterian Hospital. 218 S. Twentieth St.

1901. Taylor, J. Gurney, M.D., Physician to the Pennsylvania Institution for the Instruction of the Blind. 6041 Drexel Road, Overbrook, Pa.

1886. Taylor, John Madison, A.B. and A.M. (Princeton), M.D., Adjunct Professor of Non-Pharmaceutical Therapeutics in the Temple University; Editor *Monthly Cyclopedia of Practical Medicine;* Consulting Physician to the Elwyn, Pa., and the Vineland, N. J., Training Schools for Feeble-minded Children. 1504 Pine St.

1887. Taylor, William J., M.D., Surgeon to the Orthopædic Hospital and Infirmary for Nervous Diseases, and to St. Agnes' Hospital; Consulting Surgeon to the West Philadelphia Hospital for Women. 1825 Pine St.

1886. Taylor, William L., M.D. 1340 N. Twelfth St.

1910. Thomas, Benjamin A., M.D., Professor of Genito-urinary Surgery in the Philadelphia Polyclinic and College for Graduates in Medicine; Instructor in Surgery in the University of Pennsylvania; Surgeon-in-Chief to the Outpatient Department of the University Hospital. 116 S. Nineteenth St.

1867. Thomas, Charles Hermon, M.D. 3634 Chestnut St.

1907. Thomas, Thomas Turner, M.D., Instructor in Surgery in the University of Pennsylvania; Assistant Surgeon to the University Hospital; Assistant Surgeon to the Philadelphia General Hospital. 2005 Chestnut St.

1897. Thomson, A. G., M.D., Assistant Ophthalmic Surgeon to the University Hospital; Assistant Ophthalmologist to the Orthopædic Hospital and Infirmary for Nervous Diseases. 1516 Locust St.

1896. Thorington, James, A.M., M.D., Member of the American Ophthalmological Society; Ophthalmologist to the Vine-

ELECTED

land and Elwyn Training Schools for Feeble-minded Children. 120 S. Eighteenth St.

1898. Thornton, Edward Q., M.D., Assistant Professor of Materia Medica in the Jefferson Medical College. 1331 Pine St.

1896. Toulmin, Harry, M.D., Medical Director of the Penn Mutual Life Insurance Company. 925 Chestnut St.

1908. Tracy, Stephen E., M.D., Gynecologist to the Stetson Hospital. 1429 Spruce St.

1901. Tucker, Henry, M.D. 2000 Pine St.

†1894. Tunis, Joseph Price, M.D., Clinical Assistant to the Nose and Throat Dispensary of the Polyclinic Hospital. 1426 Pine St.

1901. Turner, John B., M.D., Clinical Assistant in the Ophthalmological Out-patient Department of the Jefferson Medical College Hospital. 1833 Chestnut St.

1866. Tyson, James, M.D., LL.D., Emeritus Professor of Medicine in the University of Pennsylvania and late Physician to the Hospital of the University of Pennsylvania; Physician to the Pennsylvania Hospital. 1506 Spruce St.

1897. Tyson, T. Mellor, M.D., Physician to the Philadelphia General Hospital; Assistant Physician to the Hospital of the University of Pennsylvania; Physician to the Rush Hospital, the Philadelphia Lying-in Charity Hospital, and the Children's Aid Society of Philadelphia. 1506 Spruce St.

1904. Uhle, Alexander A., M.D., Assistant Instructor in Genito-urinary Diseases in the University of Pennsylvania; Assistant Surgeon to the Dispensary for Genito-urinary Diseases, University Hospital; Assistant Genito-urinary Surgeon to the Philadelphia General Hospital; Assistant Surgeon to the Dispensary of the German Hospital. 1327 Jefferson St.

1907. Ullom, Josephus Tucker, A.B., M.D., Member of the Staff of the Henry Phipps Institute for Tuberculosis. 24 Carpenter St., Germantown.

1873. Van Harlingen, Arthur, Ph.B. (Yale), M.D., Emeritus Professor of Diseases of the Skin in the Philadelphia Polyclinic; Dermatologist to the Children's Hospital. 1831 Chestnut St.

1903. Van Pelt, William Turner, M.D., Ophthalmic Surgeon to the Episcopal Hospital. 1528 Spruce St.

ELECTED

1893. VANSANT, EUGENE LARUE, M.D., Professor of Diseases of the Throat and Nose in the Philadelphia Polyclinic; Visiting Physician to the Throat, Nose, and Ear Department of the Howard Hospital. 1929 Chestnut St.

*1897. VEASEY, CLARENCE A., A.M., M.D., Formerly Assistant Professor of Ophthalmology in the Jefferson Medical College, and Assistant Ophthalmologist to the Jefferson Medical College Hospital; Formerly Ophthalmic Surgeon to the Methodist Episcopal Hospital, Philadelphia. Suite 205, Traders' Bank Building, Spokane, Wash.

†1883. VINTON, CHARLES HARROD, A.M., M.D. Hotel New Chatham, Atlantic City, N. J.

1903. WADSWORTH, WILLIAM SCOTT, M.D. 207 S. Forty-fifth St.

1906. WALKER, JOHN K., M.D., Physician to the Out-patient Department of the Pennsylvania Hospital; Physician to the Dispensary of the Mary J. Drexel Home. 1632 Spruce St.

1907. WALKER, WARREN, M.D., Surgeon to the Dispensary of the Episcopal Hospital; Surgeon to the Dispensary of the Children's Hospital; Assistant Surgeon in the Clinic for Genito-urinary Diseases of the Polyclinic Hospital. 1632 Spruce St.

1904. WALSH, JOSEPH, A.M., M.D., Visiting Physician to the White Haven Sanatorium; Consulting Physician to the Department of Tuberculosis at the Philadelphia General Hospital. 732 Pine St.

1910. WARD, E. TILLSON, M.D. 1415 S. Broad St.

1893. WARREN, JOSEPH W., M.D., Associate Professor of Physiology in Bryn Mawr College. Bryn Mawr, Pa.

1895. WATSON, ARTHUR W., M.D., Professor of Diseases of the Throat and Nose in the Philadelphia Polyclinic and College for Graduates in Medicine; Laryngologist to the Jewish Hospital; Laryngologist and Aurist to the Mt. Sinai Hospital; Laryngologist to the Home for Incurables. 126 S. Eighteenth St.

1886. WATSON, EDWARD W., M.D., Physician to the Magdalene Home. 38 S. Nineteenth St.

1903. WEBER, CHARLES H., M.D., Physician to the Episcopal Hospital; Physician to the Dispensary of the Children's Hospital. 2048 Pine St.

ELECTED

1906. Weisenburg, Theodore H., M.D., Professor of Clinical Neurology and of Neuropathology in the Medico-Chirurgical College; Neurologist to the Philadelphia General Hospital; Consulting Neurologist to the State Hospital for the Insane at Norristown and to the State Hospital for the Feeble-minded and Epileptic at Spring City. 2030 Chestnut St.

1883. Welch, William M., M.D., Chief Diagnostician to the Bureau of Health, and Consulting Physician to the Municipal Hospital for Contagious Diseases; Consulting Physician to the Northern Dispensary and the Northern Home for Friendless Children. 1411 Jefferson St.

1897. Wells, William H., M.D., Associate in Obstetrics in the Jefferson Medical College; Assistant Obstetrician to the Jefferson Medical College Hospital. 1135 Spruce St.

1893. Westcott, Thompson S., M.D., Associate in Diseases of Children in the University of Pennsylvania; Visiting Physician to the Methodist Episcopal Hospital; Assistant Physician to the Children's Hospital; Pediatrist to the Jewish Hospital. 1720 Pine St.

1884. Wharton, Henry R., M.D., Clinical Professor of Surgery in the Woman's Medical College of Pennsylvania; Surgeon to the Presbyterian and the Children's Hospitals; Consulting Surgeon to the Bryn Mawr Hospital, St. Christopher's Hospital for Children, and the Pennsylvania Institution for the Deaf and Dumb. 1725 Spruce St.

1901. White, Courtland Y., M.D., Director of the Pathological Laboratory of the Episcopal Hospital; Pathologist to the Children's Hospital and to the Kensington Hospital for Women; Chief Bacteriologist to the Board of Health of Philadelphia. 1808 Diamond St.

1878. White, J. William, M.D., Ph.D., LL.D. (Hon. Aberdeen), John Rhea Barton Professor of Surgery in the University of Pennsylvania; Senior Surgeon to the University Hospital; Fellow of the American Surgical Association and of the American Association of Genito-urinary Surgeons. 1810 S. Rittenhouse Square.

1905. Whiteway, Harold M., M.D. 1924 Chestnut St.

1898. Whiting, Albert D., M.D., Surgeon to the Germantown Hospital; Assistant Surgeon to the German Hospital; Surgeon to the Southern Home for Destitute Children;

ELECTED

Surgeon to the Out-patient Department of the German Hospital. 1523 Spruce St.

1907. Williams, Carl, B.S., M.D., Assistant Ophthalmic Surgeon to the Germantown Hospital; Assistant Surgeon to the Dispensary for Diseases of the Eye at the University Hospital. N. E. cor. Schoolhouse Lane and Greene St., Germantown.

1902. Willson, Robert N., Jr., M.D., Pathologist to the Presbyterian Hospital; Assistant Physician to the Philadelphia General Hospital. 1708 Locust St.

1881. Wilson, H. Augustus, M.D., Professor of Orthopedic Surgery in the Jefferson Medical College; Emeritus Professor of Orthopedic Surgery in the Philadelphia Polyclinic; Consulting Orthopedic Surgeon to the Philadelphia Lying-in Charity Hospital, and the Kensington Hospital for Women; Senior Orthopedic Surgeon to the Philadelphia General Hospital. 1611 Spruce St.

1874. Wilson, James C., A.M. (Princeton), M.D., Professor of the Practice of Medicine and of Clinical Medicine in the Jefferson Medical College, and Physician to the Hospital of the same; Physician-in-Chief to the German Hospital; Attending Physician to the Pennsylvania Hospital. 1509 Walnut St.

1902. Wilson, Samuel M., M.D. 1517 Arch St.

1897. Wilson, W. Reynolds, M.D., Visiting Physician to the Philadelphia Lying-in Charity Hospital. 1709 Spruce St.

1904. Wister, James W., M.D., Physician to the Out-patient Department of the Germantown Hospital. 5430 Germantown Ave.

*1901. Witmer, A. Ferree, M.D. Freeport, Long Island, N. Y.

1893. Wood, Alfred C., M.D., Assistant Professor of Surgery in the University of Pennsylvania; Surgeon to the University, the Philadelphia General, St. Timothy's, and the Howard Hospitals. 128 S. Seventeenth St.

1900. Wood, George B., M.D., Instructor in Laryngology in the University of Pennsylvania; Assistant in the Clinic for Diseases of the Nose and Throat at the Polyclinic Hospital. 129 S. Eighteenth St.

1865. Wood, Horatio C., M.D., LL.D. (Yale and Lafayette), Emeritus Professor of Materia Medica and Therapeutics in the University of Pennsylvania; Associate Fellow in Medicine and Surgery of the American Academy of Arts

ELECTED

and Sciences; Member of the National Academy of Science. 4107 Chester Ave.

1903. Wood, Horatio C., Jr., M.D., Associate Professor of Pharmacology in the University of Pennsylvania. 434 S. Forty-fourth St.

1907. Wood, Walter A., M.D. 255 S. Sixteenth St.

1880. Woodbury, Frank, M.D., Secretary to the Committee on Lunacy of the Board of Charities of Pennsylvania. 218 S. Sixteenth St.

1901. Woods, Richard F., M.D., Assistant Surgeon to the Gynecean Hospital. 1501 Spruce St.

†1897. Woodward, George, M.D. W. Willow Grove Ave., Chestnut Hill, Philadelphia.

1903. Worden, Charles B., M.D., Associate in Diseases of the Stomach and Intestines in the Philadelphia Polyclinic; Physician to the Dispensary of the Presbyterian Hospital; Anesthetizer to the Orthopedic Department of the University Hospital; Physician to the Presbyterian Orphanage. 322 S. Sixteenth St.

1889. Young, James K., M.D., Professor of Orthopedic Surgery in the Philadelphia Polyclinic; Clinical Professor of Orthopedic Surgery in the Woman's Medical College of Pennsylvania; Associate in Orthopedic Surgery in the University of Pennsylvania, and Assistant Orthopedic Surgeon to the University Hospital. 222 S. Sixteenth St.

1894. Zentmayer, William, M.D., Attending Surgeon to the Wills Eye Hospital; Ophthalmic Surgeon to St. Agnes' Hospital; Ophthalmologist to the House of Refuge. 1819 Spruce St.

1899. Ziegler, S. Lewis, A.M., M.D., Sc.D., Attending Surgeon to the Wills Eye Hospital; Ophthalmic Surgeon to St. Joseph's Hospital; Membre Société Française d'Ophtalmologie. 1625 Walnut St.

1887. Ziegler, Walter M. L., A.M., M.D. 1418 N. Seventeenth St.

1895. Zimmerman, Mason W., M.D., Consulting Ophthalmic Surgeon to the Germantown Hospital. 1522 Locust St.

ASSOCIATE FELLOWS

[Limited to Fifty, of whom Twenty may be Foreigners]

American

ELECTED

1909. Billings, Frank, M.D., 335 E. Twenty-second Street, Chicago, Illinois.

1876. Billings, John S., M.D., U. S. A., Astor Library Building, 40 Lafayette Place, New York City, New York.

1886. Bowditch, Henry P., M.D., 688 Boylston Street, Boston, Massachusetts.

1877. Chaille, Stanford E., M.D., University Building, New Orleans, Louisiana.

1886. Cheever, David W., M.D., 557 Boylston Street, Boston, Massachusetts.

1893. Councilman, William T., M.D., Harvard Medical College, Boston, Massachusetts.

1909. Crile, George W., M.D., 1021 Prospect Avenue, S. E., Cleveland, Ohio.

1909. Dana, Charles Loomis, M.D., 53 West Fifty-third Street, New York City, New York.

1892. Emmet, Thomas Addis, M.D., 91 Madison Avenue, New York City, New York.

1892. Fitz, Reginald H., M.D., 81 Arlington Street, Boston, Massachusetts.

1895. Fletcher, Robert, M.D., Army Medical Museum, Washington, D. C.

1903. Gorgas, William C., M.D., U. S. A., Washington, D. C.

1891. Jacobi, A., M.D., 19 East Forty-seventh Street, New York City, New York.

1909. Janeway, Edward G., M.D., LL.D., 36 West Fortieth Street, New York City, New York.

1895. McBurney, Charles, M.D., 28 West Thirty-seventh Street, New York City, New York.

ELECTED

1909. Mall, Franklin P., M.D., 1514 Bolton Street, Baltimore, Maryland.
1906. Mayo, William J., M.D., Rochester, Minnesota.
1906. Pilcher, Lewis Stephen, M.D., 386 Grand Avenue, Brooklyn, New York.
1886. Reeve, John C., M.D., LL.D., S. W. corner Third and Wilkinson Streets, Dayton, Ohio.
1906. Shattuck, Frederick C., M.D., 135 Marlborough Street, Boston, Massachusetts.
1896. Sternberg, George M., M.D., U. S. A., 1019 Sixteenth Street N. W., Washington, D. C.
1896. Tiffany, L. McLane, M.D., 831 Park Avenue, Baltimore, Maryland.
1909. Wadsworth, Oliver F., M.D., 526 Beacon Street, Boston, Massachusetts.
1894. Warren, J. Collins, M.D., 58 Beacon St., Boston, Massachusetts.
1894. Weir, Robert F., M.D., 11 East Fifty-fourth Street, New York City, New York.
1892. Welch, William H., M.D., Johns Hopkins Hospital, Baltimore, Maryland.

Foreign

1890. Baccelli, Guido, Rome, Italy.
1908. Bannerman, W. B., M.D., Lt. Col. I. M. S., 11 Strathearn Place, Edinburgh, Scotland.
1894. Brunton, Sir T. Lauder, M.D., 10 Stratford Place, London, W., England.
1903. Finlay, Charles J., M.D., Havana, Cuba.
1899. Fraser, Sir Thomas R., M.D., LL.D., F.R.C.P., F.R.S., 13 Drumsheigh-Gardens Edinburgh, Scotland.
1903. Horsley, Sir Victor Alexander Haden, F.R.S., 25 Cavendish Square, London, England.
1906. Hutchinson, Jonathan, M.D., LL.D., F.R.S., 15 Cavendish Square, London, W., England.
1896. Jaccoud, Prof. S., Rue Tronchet 35, Paris, France.
1894. Jackson, J. Hughlings, M.D., 3 Manchester Square, London, England.
1893. von Jaksch, Rudolf, M.D., Prague, Bohemia.
1903. Kocher, Prof. Theodor, M.D., Berne, Switzerland
1896. Leyden, Ernst, M.D., Berlin, Germany.

ELECTED

1877. Lord Lister, M.D., LL.D., F.R.S., 12 Park Crescent, Portland Place, London, W., England.

1909. Macallum, Archibald B., M.A., M.B., Ph.D., Sc.D., LL.D., F.R.S., 59 St. George Street, Toronto, Canada.

1906. Myles, Sir Thomas, M.D., 33 Merion Square, W., Dublin, Ireland.

1896. Pye-Smith, P. H., M.D., 48 Brook St., London, W., England.

1898. Roddick, Thomas G., M.D., 80 Union Avenue, Montreal, Canada.

1908. Ross, Major Ronald, M.D., R.A., Liverpool School of Tropical Medicine, Liverpool, England.

1869. Valcourt, Th. de, M.D., Cannes, France.

1904. Waldeyer, Prof. Wilhelm, M.D., Berlin, Germany.

CORRESPONDING MEMBERS

ELECTED

1880. Carrow, Flemming, M.D., Washington Arcade, Detroit, Michigan.

1880. Chiara, Domenico, M.D., Florence, Italy.

1886. Dey, Kanny Lall, M.D., Calcutta, India.

1885. Rendu, Jean, M.D., Lyons, France.

NECROLOGICAL LIST

FELLOWS

WILLIAM B. STANTON,	February 13, 1910
WHARTON SINKLER,	March 16, 1910
BARTON H. POTTS,	May 8, 1910
D. F. WOODS,	July 28, 1910
WALTER F. ATLEE,	August 18, 1910
DE FOREST WILLARD,	October 14, 1910
JAMES B. WALKER,	October 18, 1910
JOHN C. DA COSTA,	December 6, 1910

CONTENTS

List of Officers and Standing Commitees iii
List of Presidents of the College v
List of Fellows of the College vii
List of Associate Fellows of the College xlvii
List of Corresponding Members l
Necrological List for 1910 li
Meeting of the College of Physicians upon the Death of Dr. Sinkler, March, 8, 1910 lv
Memoir of J. Alison Scott, M.D. By Alfred Stengel, M.D. . . . lxi
Memoir of Richard Alexander Fullerton Penrose, M.D. By Barton Cooke Hirst, M.D. lxviii

Annual Address of the President. By James Tyson, M.D., LL.D. . 1
Chronic Pancreatitis. By Joseph Sailer, M.D. 8
A Clinical Study of the Cammidge Reaction in the Urine. By John M. Swan, M.D., and John J. Gilbride, A.M., M.D. 22
Symptomatic Relief in Aortic Aneurysm by Wiring and Galvanism (Moore-Corradi Method). By E. J. G. Beardsley, M.D., L.R.C.P. 69
Operations for Brain Tumors. By William G. Spiller, M.D. . . . 83
Actinomycosis (Streptothricosis) in Man, with the Report of a Case of Pulmonary Involvement. By Alfred C. Wood, M.D., and Augustus A. Eshner, M.D. 90
The Clinical Value of Skiagraphy in Diseases of the Nasal Accessory Sinuses. By Cornelius G. Coakley, M.D. 112
The Pathology of Mastoiditis as Revealed by the *X*-ray. By Sidney Lange, M.D. 117
Vein-to-Vein Transfusion of Blood. By George Morris Dorrance, M.D., and Nate Ginsburg, M.D. 131
Hemichorea, Hemiataxia, Hemiparesis, and Dilated Pupil, Probably Due to a Lesion of the Superior Cerebellar Peduncle. By Charles K. Mills, M.D. 136
The Difference Between Systolic Pressure in the Arm and in the Leg in Aortic Regurgitation. By H. A. Hare, M.D. 143

The Gross Pathology of the Heart, with Special Reference to Sclerosis of the Mitral Valve. By Robert N. Willson, M.D. 152
Practical Treatment. The Fundamental Principles of Therapeutics. By John H. Musser, M.D., LL.D. 158
The Report of a Case of Blood Dyscrasia Following Calomel. By Walter G. Elmer, M.D. 169
The Induction of Pancreatic Activity by the Removal of the Adrenals. By J. E. Sweet, M.D., and Ralph Pemberton, M.D. 176
Meningitis and Disease of the Radicular Nerves in Tabes Dorsalis. By John H. W. Rhein, M.D. 222
Pellagra, with a Report of Two Cases with Necropsy. By Paul V. Anderson, M.D., and William G. Spiller, M.D. 246
Concerning Nervous Disturbances Following Surgical Operations and Anesthesias. By S. Wier Mitchell, M.D. 262
Postoperative Psychoses. By J. G. Mumford, M.D. 266
The Diagnosis of Postoperative Insanity. By John Chalmers Da Costa, M.D. 274
Postoperative Insanities. By Edward N. Brush, M.D. 289
Dehydration by Dietetic Measures. An Interpretation of the Karell, Oertel, and Widal Treatments of Circulatory and Renal Diseases. By A. Magnus-Levy, M.D. 308
Paroxysmal Pulmonary Edema and its Treatment. By Alfred Stengel, M.D. 325
A Metabolic Study of Myotonia Atrophica, with the Report of Two Cases. By Ralph Pemberton, M.S., M.D. 353
Anterior Poliomyelitis. By Joseph S. Neff, M.D. 371
Some Recent Clinical Investigations of Poliomyelitis. By Charles K. Mills, M.D. 379
Recent Studies Concerning the Etiology of Epidemic Poliomyelitis. By Paul A. Lewis, M.D. 395
On the Surgical Treatment of Paralytic Talipes, with a Report of Cases of Tendon Transplantation and Arthrodesis. By Astley P. C. Ashhurst, M.D. 412

APPENDIX

Annual Report of the Library Committee for 1910 421
Abstract of the Report of the Committee on Mütter Museum, 1910 . 430
List of Papers: Section on Ophthalmology 431
List of Papers: Section on Otology and Laryngology 434
List of Papers: Section on General Medicine 436

MEETING OF THE COLLEGE OF PHYSICIANS UPON THE DEATH OF DR. SINKLER, MARCH 18, 1910

Dr. George E. de Schweinitz, President.

The reason for this special meeting of the College is stated in the notice which each member of our Fellowship has received. We are assembled in order that we may make record of the great sorrow and of the grievous loss which have come to our collegiate body in the death of the Vice-President, Dr. Wharton Sinkler.

He was an important officer and distinguished Fellow of this College, who, even when mortally stricken, remembered the needs of our institution in an act which, with his loyal service of well-nigh twoscore years, must place his name high on the roll of eminent benefactors and enshrine his memory in reverent gratitude. A wise physician, a noble friend, a respect-compelling man, who has given fine example of the conduct of the higher life.

Dr. S. Weir Mitchell.

Mr. President and Fellows: No doubt my long association with Dr. Sinkler in various ways has caused me to be selected to speak first in memory of this much-loved Fellow of the College.

A number of the gentlemen now present went from his funeral to a commemorative meeting of the Managers of the Infirmary for Nervous Diseases, and gather here again on the third occasion in one day to recall anew the memory of our friend. This is sufficient proof to you how wide and strong were Dr. Sinkler's associations with the medical life of Philadelphia. His relations with the other medical institutions of this city must be left to be considered on some other day.

I think very few of the younger men of the College realize the enormous amount of labor ungrudgingly given to our important

committees in the College. This is sometimes work upon which the prosperity of the College depends; at other times it has some relation to the community at large. Dr. Sinkler occupied for I do not know how many years, but I think from the beginning, this double relation owing to his place on the committee upon the Nurses' Directory. The position has been a difficult one to fill, as you know, and yet the work has been carried on greatly to the advantage of the College and the community. We have been enabled of late to still further enlarge without cost to nurses this useful portion of our labors.

I personally feel Dr. Sinkler's loss very deeply. I have had many assistants in my long professional life, and almost without exception they have become busy and successful physicians. The first, Dr. George Gerhard, was succeeded by Dr. Sinkler, who left me when I declined general practice and was able to throw into his hands most gladly a large part of the family practice which had formerly occupied me. As he was my assistant at the Infirmary for Nervous Diseases, when the clinics became overwhelmingly large, he was selected to take charge of one of them, and has had a long and successful relation to that institution, for the prosperity of which he has been enabled to do a great deal.

I could say a great deal more, but much that I would say is out of place and out of time, and had better be left for another more formal and more extended notice. I thank you, however, for the opportunity to say these few words concerning my friend.

Dr. Frederick P. Henry.

Mr. President and Fellows of the College: There is nothing more difficult than to fix the date of the beginning of a friendship. I have sometimes thought that it is, in the very nature of things, impossible. I have been blessed, and still am, with many friends. I do not say this in any boastful spirit—far from it, for I often wonder at it. I merely mention it as a fact without which life would have been not only "weary, stale, flat, and unprofitable," but, I verily believe, impossible. I have sometimes amused or, rather, perplexed myself with endeavoring to

trace the beginning of this or that friendship, but I have never succeeded in doing so, and I never shall. It is, as I intimated, impossible in the very nature of things. We might as well endeavor to recall the circumstances of our own birth as those of the birth of something that has become an integral part of ourselves.

The first meeting with Dr. Sinkler that I can distinctly recall was in 1874 at the house of Dr. Herbert Norris, where we met to arrange our terms of service at the Episcopal Hospital, to the staff of which I had just been elected. I had expected to be assigned the months of July, August, and September as my term of service, and was greatly relieved when Dr. Sinkler announced that he preferred to retain them for himself. He did so because hospital work at that season interfered the least with his practice. This may serve to illustrate his devotion to the practical duties of his profession. I know of no similar instance. This, I repeat, was the first of our meetings that I distinctly remember. The last was less than two months ago at the table of a genial host, an even older friend of his than I. During the thirty-six years that intervened our friendship began, continued, and is now, I trust, not ended.

I do not mean to arrogate to myself any exclusive rights in Dr. Sinkler's friendship. He was the least monadic of men and counted his friends by the score. He possessed, in high degree, that occult quality miscalled personal magnetism and described by Goethe under the title of "daemonic influence." It is, in my opinion, doubtful whether, without this nameless attribute, even his indomitable industry, his unquestioned ability, and his sound judgment would have achieved the brilliant success which was his; but we cannot conceive of Dr. Sinkler without it.

Dr. Sinkler was a gentleman of that oldest of schools which is free to all and from which the pupil is never graduated, but is always advancing on the royal road of honor; the school, on the hard benches of which sat as humble disciples, up to the last day of their lives, such men as Colonel Newcome, D. Hayes Agnew, and William F. Norris.

The following minute was then adopted by the College of Physicians:

Minute on the death of Dr. Wharton Sinkler, adopted by the College of Physicians at a special meeting held on March 18, 1910.

It is with profound regret that the College of Physicians has received the announcement of the death of its Vice-President, Dr. Wharton Sinkler. Many of those present are reminded of a similar occasion, on December 28, 1889, when the College held a special meeting to take action upon the death of its then Vice-President, Dr. James H. Hutchinson.

Elected a Fellow in 1872, Dr. Sinkler soon became prominent in the various activities of the College, and especially in connection with the Directory for Nurses, of which for many years he was Chairman. In virtue of this position he was a member of the Council, and in spite of the exigencies of a large practice and the engagements incident to numerous other public positions, he was a regular attendant at its meetings. His judicial temperament combined with his knowledge of men and his imperturbable good temper made him one of the most valuable members of this important body.

As a contributor to medical literature, as a hospital physician, and as a practitioner Dr. Sinkler was equally distinguished. His writings, mostly dealing with the clinical aspects of neurology, have made his name familiar throughout the medical world.

In 1872 he was elected to the Staff of the Episcopal Hospital, and from that time until his death he was continuously in hospital service. It was, however, as a practitioner that he was preëminent. Many years ago his practice assumed large proportions, and was most exacting up to the time of his death. No pressure of work, however, could disturb an equanimity which was the wonder and admiration of all who knew him. In the midst of labors which would have overwhelmed a man of ordinary endurance, he also found abundant time for the functions which were incidental to his social position.

The College of Physicians tacitly recognizes the fact that the chief qualification for its Fellowship is character. No amount of ability can atone for the lack of that wholesome equilibrium of the moral faculties which we recognize as character. It may be pedantic, it may be old-fashioned, to insist upon it, but so long as the College upholds the standard of living and thinking set by such men as Sinkler, so long will it maintain its present high position of dignity and influence. Wharton Sinkler was an epitome of what the College, as a whole, should be.

It was moved and seconded that the Minute be adopted and copied in full in the records of the College. Also, that a copy be sent to the family of the late Vice-President. Carried.

Dr. J. C. Wilson.

Mr. President and Fellows of the College: An occasion such as this, when the Fellows come together to express their sense of loss at the death of one of their colleagues and their appreciation of his character and abilities, constitutes a function dominated by personal feelings. Reflections upon the uncertainty of life are mingled with sentiments of regard for associates whom we have come to know and appreciate as members of a common profession and workers in an institution of comradeship in learning.

Detained by my lecture, I entered too late to hear Dr. Mitchell's remarks, but I heard the reading of the Minute and Dr. Henry's address. I do not propose to go into any extended consideration of Dr. Sinkler's position as a member of our profession or as a Fellow of this College. I desire, however, to emphasize two characteristics upon which my thoughts have often dwelt, and which, it seems to me, have had much to do in the deep and lasting friendships which were his in such numbers.

He was in a sense quite unlike that in which the phrase is generally used, a leader in his profession, not only in this community, but also far beyond its borders—not a leader of men in the dramatic sense, with obvious effort to keep himself in the

limelight, but as the result of traits and abilities which were recognized by all his associates—a chosen leader. His knowledge of medicine as an art was everywhere appreciated; his contributions to medical literature, far too few, were of great practical value; he was possessed of a fondness for institutional work and a remarkable gift of organization. With this spirit of leadership there was associated a certain unconsciousness of self, most impressive to those who had the opportunity of observing it in his conversation and conduct. Forgetfulness of self, devotion to his family, devotion to his friends were marked characteristics. Indeed, his unconsciousness of self, it always seemed to me, was the keynote of his success and usefulness in life. Of him it may be truly said that he "dwelt on heights and knew not they were high."

Upon motion of Dr. Mitchell the meeting was adjourned.

MEMOIR OF J. ALISON SCOTT, M.D.

By ALFRED STENGEL, M.D.[1]

Joseph Alison Scott was the son of John Scott and Annie Eyster Scott. He was born at Huntingdon, Pa., on May 20, 1865; subsequently for a short time the family lived at Pittsburg, but finally came to Philadelphia in 1877. His father was descended from Scotch-Irish ancestors who had long resided in Pennsylvania, and there is some evidence that the original home was near Londonderry. John Scott, the great-great-grandfather of the subject of this memoir, in 1740 took up his residence on a farm in what is now Adams County. This was known as "Rosenhill," but has become more famous in recent times under the name of the "Sandoe Farm," on the battlefield of Gettysburg. For over a century the Scott family continued to live in this section of Pennsylvania. The grandfather of Dr. Scott served his country as Major in the British War of 1812, and afterward was a member of Congress (about 1830). His father occupied even more conspicuous positions in the State and Nation. At the beginning of the Rebellion he was commissioned Assistant Adjutant General, and after the war he was elected United States Senator, occupying this position from 1869 to 1875. From 1875 to the end of his life he was at the head of the legal department of the Pennsylvania Railroad, having charge of the lines west of Pittsburg from 1875 to 1877 and of the eastern division and the whole system from 1877 to 1895, when he retired from active service. His death occurred in 1896.

Dr. Scott's mother lived in Chambersburg at the time of her

[1] Read June 1, 1910.

marriage, and is descended from German ancestors. She is now living in Philadelphia.

Dr. Scott was the ninth of a family of ten children, six brothers and four sisters. His boyhood days were spent at Huntingdon and Pittsburg. His early education and preparation for College was received at Hastings' Academy, which he entered when his father took up his residence in Philadelphia. In 1881 he entered the college department of the University of Pennsylvania, and graduated with the degree of A.B., in 1885. Being uncertain in his choice of a profession, he entered the service of the Pennsylvania Railroad after his graduation from college, but remained only a year, when he began the study of medicine, graduating in 1889. During his seven years of study in the University of Pennsylvania he established a reputation for earnestness and studiousness in the prescribed work of his classes, for interest in athletics of the cleanest and wholesomest type and for excellence of performance in those branches in which he took part, for loyalty to every cause of his alma mater, and for the highest kind of character, that gained for him a host of friends, now engaged in every walk of life. He was neither a student devoted only to books, nor an athlete with keener interest in sports than in academic standing. He was never loud in professions of uprightness, but there never was a truer Christian character. During these student years he always ranked among the best men of his classes, but he at the same time found leisure to devote to exercise. He was known as one of the best cricketers in the country, playing on the teams of the Gentlemen of Philadelphia in the International matches from 1883 to 1886 and again in 1888. During 1884 he accompanied the first American Cricket Eleven that visited England, and returned with the best batting average for the trip. In 1894 he again played for the Gentlemen of Philadelphia against the English team, and was captain of his eleven. He played on his University Eleven during the four years of his undergraduate course, and had the unique experience of acting as captain of the eleven during his Freshman year and again during his three postgraduate years. During later years he continued an interest in atheletic affairs, serving on various committees of the

Athletic Asociation of the University, and in the fall of 1906 he was invited to accompany as mentor and guide the University of Pennsylvania Cricket Team on its visit to England. During this journey he renewed many old acquaintanceships of his own cricket playing days, and his record and reputation did much to make the success of the venture.

As a medical student, I well remember the favorable impression made upon all his classmates from the beginning of our work together. When any little class difficulties threatened the present and future peace—and I fear that particular class was somewhat prone to early difficulties—I vividly recall how the genial, friendly manner of Al Scott smoothed out our ruffled members. Long before graduation time had reached us he was the friend of every classmate, and every classmate had come to regard him with a real affection.

Immediately after graduation from the Medical School, upon invitation of Dr. Osler, who was then leaving Philadelphia to take up his work at Baltimore, Dr. Scott became one of the medical internes at the Johns Hopkins Hospital, where he continued until April, 1890. He then accepted a similar position, after election by the Board of Managers, in the Pennsylvania Hospital, where his talents and faithful service met such appreciation that the was appointed in 1893 as physician to the Out-patient Department. His work as a physician in the Out-patient Department was of the quiet, thorough sort that gives to the patient the best medical attention that can be rendered and cultivates the capacities of the physician to their fullest degree. His six years' service here entitled him to receive the next appointment, that of Visiting Physician in the same hospital, the highest distinction that any man could wish to attain in the line of medical advancement. This elevation coming to him in 1899, just ten years after graduation, was richly merited by faithful service and practical achievement.

In the meantime he had entered the service of his alma mater, in 1893, as Assistant Demonstrator of Pathological Anatomy, and continued in the Pathological Department until 1895, at the same

time engaging himself unofficially but most usefully to himself and students as a Quiz Master in Pathology. In 1895 he was transferred to the post of Demonstrator of Physical Diagnosis and Instructor in Clinical Medicine, in which positions he remained until 1901, when his election to the position of Professor of Medicine in the Philadelphia Polyclinic and College for Graduates in Medicine required his resignation from the University. After two years' occupancy of this new position he was recalled by his alma mater to the post of Adjunct Professor of Medicine, which he held up to the time of his death.

In all of these official positions his work was characterized by painstaking and conscientious observance of the duties and requirements of the post assigned him, and his colleagues were never in the least doubt of the thoroughly trustworthy fulfilment of all his obligations. What he undertook to do he did with all his power and did it well. No higher record of efficiency and faithful service could be expected of anyone.

During the years of his active medical work he contributed to medical literature a number of papers embodying results of clinical study that are uniform in this one respect—all are marked by careful thought and accurate study. His aim was manifestly to attain the greatest precision and accuracy, and his publications, though fewer than those of some of no greater experience, are characterized by much greater reliability than are those of more prolific writers. The most valuable of his contributions and the ones that will have the most lasting usefulness are his studies on perforation of the bowel in typhoid fever. The three papers on this subject will long remain the source of information and quotation for those who shall wish to study or discuss this important topic. Those who at this day read what he has written, and who may be unfamiliar with the history of the subject, will perhaps miss the important fact that when he took up the question the early symptoms and diagnostic criteria—now so well appreciated—were unrecognized, and that the accepted indications were those of the later stages of the condition, when the only available treatment—surgical interference—could be of no possible use. The importance

of Scott's studies lies in the fact that he with others established the means of early diagnosis and therefore of treatment at a stage of probable usefulness. Whatever of merit his surgical colleagues at the Pennsylvania Hospital may have for their successes in the operative treatment of typhoid perforation, much of it is attributable—and none will more cheerfully grant this than both his medical and surgical associates—to the careful study of the early indications of perforation made and published by him.

While his other studies were less conspicuously useful, the same quality of work pervades all he did or wrote. Those of us who were his associates in hospital or medical society will readily recall that when he was scheduled for a paper or clinical demonstration, something worth hearing was always presented. Many graduates of the several medical schools of Philadelphia will long remember his clinics at the Pennsylvania Hospital, and some will, with particular interest, recall the combined medical and surgical clinics of himself and Dr. Le Conte, one of which was the foundation of a useful paper on "Pyopericarditis."

For eight years he served as Associate Medical Director of the Penn Mutual Life Insurance Company of Philadelphia, and interested himself largely in the matter of improved methods of medical examination.

I believe he contributed no little toward the adoption on the part of Insurance Companies of a broader point of view and a more liberal attitude toward expert medical opinion as bearing upon individual cases.

Dr. Scott was a member of most of the local medical societies, and in his early years was one of the active participants in the work of the Pathological Society. Subsequently his activities were transferred to the Section on General Medicine of the College of Physicians and to the Pediatric Society, of which he was one of the founders. In addition to the local societies, he was a member of the American Medical Association and an Associate member of the Association of American Physicians.

He was elected to Fellowship in this College in 1895, and held his first official position in 1900, when he was made a member of the

Committee on Entertainments, continuing in this position until 1906. His next appointment was as a member of the Committee on the Mütter Museum, serving in this capacity from 1903 up to the end of his life. He was elected to the Council of the College in 1906 and remained a member of that body until his death. During the Academic year of 1908–09 he was the Chairman of the Section on General Medicine.

In 1896 Dr. Scott married Miss Frances Pepper, the daughter of Dr. George Pepper, the niece of Dr. William Pepper, and granddaughter of Dr. William Pepper—all distinguished physicians and Fellows of this College. Three children—Frances, Joseph Alison, and Ernest—resulted from this union, and with their mother survive him.

Twenty-five years have passed since my first acquaintance with him as a young medical student and classmate. We were associates, colleagues, and intimate friends, and little in his career was unknown to me. In all that time I never heard any man speak a disparaging word of him; nor have I the recollection of word or deed on his part that remotely touched on unkindness or uncharitableness. His nature was gentle and kind, but he was robust in his principles and his manhood, but above all he was broadly tolerant and just. No one could have been more appreciative of the merits of his contemporaries or more enthusiastic than he in the praise of their achievements. Envy and depreciation of others found no room in his heart; and hatred, malice, and all the meaner failings of men were as unknown to him as wrongdoing or positive vice.

Early in the year 1909 he contracted grip or some minor infection that in the beginning seemed trivial; but after a first apparent recovery he suffered relapses of fever and steadily failed in health and strength. His knowledge of an old valvular lesion soon aroused his own suspicions of the seat of the re-infection and the source of his recurring fever. Rest and change of climate and tonics failed to stay the disease, and he grew worse until the end, which took place at North East Harbor, on August 13, 1909.

Thus perished from the earth one of the perfect characters of our guild, whose loss is sore indeed.

BIBLIOGRAPHY

A Case of Poisoning by Rhus Toxicodendron Acquired in an Unusual Manner. The Philadelphia Medical Journal, April 22, 1899.

A Case of Acute Gangrenous Pancreatitis, with Fat Necrosis. The American Journal of the Medical Sciences, October, 1899.

A Case of Endocarditis Developed During Typhoid Fever. Read before the College of Physicians of Philadelphia, Medical Section, April, 1901. American Medicine, October 5, 1901.

A Case of Aneurysm of the Sinus of Valsalva, with Rupture into the Pericardium. Reprinted from Medicine, Wm. M. Warren, publisher, April, 1902.

Splenic Anemia. Report of Three Cases. American Journal of the Medical Sciences, November, 1903.

Regarding Croupous Pneumonia, Especially its Treatment with Carbonate of Creasote, with Dr. Chas. M. Montgomery. Read before the Section on Medicine, College of Physicians of Philadelphia, November 9, 1903. Reprinted from the Therapeutic Gazette, December 15, 1903.

Concerning the Fothergill Pictures at the Pennsylvania Hospital. University of Pennsylvania Medical Bulletin, January, 1904.

Medical and Surgical Considerations in Pyopericarditis, with Report of Cases, with Dr. Robert G. Le Conte. American Journal of the Medical Sciences, September, 1904.

Case of Cancer of the Esophagus Simulating Thoracic Aneurysm. University of Pennsylvania Medical Bulletin, December, 1904.

A Study of Fifty Cases of Perforation in Typhoid Fever. University of Pennsylvania Medical Bulletin, May and June, 1905.

A Sketch of the Life of Thomas Bond, Clinician and Surgeon. University of Pennsylvania Medical Bulletin, January, 1906.

A Further Study of Perforation of the Bowel in Typhoid Fever. New York Medical Journal, February 9, 1907.

Perforation of the Intestine in Typhoid Fever. Reprinted from International Clinics, vol. iii, 18th series, 1908.

Contributions to the Transactions of the Pathological Society of Philadelphia:

Miliary Tuberculosis, xvii, 210.

Calcification of Pleura, Probably Tuberculous in Origin, xviii, 272.

Specimens from Case of Pernicious Anemia, xix, 173.

Hypertrophy of Heart, xx, 67.

Hemorrhagic Pancreatitis with Fat Necrosis, N. S., iii, 157.

Sarcoma of Mediastinum, N. S., iii, 159.

A Case of Hyperplastic Tuberculosis of the Mediastinal Lymph Glands, N. S., v, 98.

Report of a Case of Malignant Tumor of the Testicle Resembling Chorio-epithelioma, with Metastasis, with Dr. W. T. Longcope. N. S., February, 1909, vol. xii, No. 1.

MEMOIR OF RICHARD ALEXANDER FULLERTON PENROSE, M.D.[1]

By BARTON COOKE HIRST, M.D.

Richard Alexander Fullerton Penrose, son of the Honorable Charles Bingham Penrose and his wife, Valeria Fullerton Biddle, was born at Carlisle, Pennsylvania, March 24, 1827. He was graduated at Dickinson College, where he received also the degree of Doctor of Laws in 1872. After completing his college course he entered the Medical Department of the University of Pennsylvania, and graduated in 1849. From 1851 until 1853 he was resident physician at the Pennsylvania Hospital; in 1853 he became physician to the Southern Home for Children, and in 1854, consulting physician at the Philadelphia Hospital. He was one of those who secured the opening of the wards of this hospital for medical instruction. He delivered clinical lectures there on diseases of women and children. He also lectured on obstetrics in the Philadelphia School of Medicine, being associated with Da Costa, Agnew, Darrach, and Hewson. In 1856 he was one of the founders of the Children's Hospital, and contributed time, energy, and money to its service. With Levick and Hunt, he founded a successful quiz association.

In 1863 the Trustees of the University of Pennsylvania elected him to the professorship of Obstetrics and Diseases of Women and Children, made vacant by the resignation of Dr. Hugh L. Hodge. He occupied the chair until 1889, when he voluntarily retired from the position, and at the same time gave up active practice.

[1] Read October 4, 1910.

He wrote very little. His articles on "Face Presentations" and on the "Mechanism of Labor" were his chief contributions to medical literature.

It was as a medical teacher that Dr. Penrose was known. It was his life work. As he acquitted himself in his chosen field, he himself would have wished to be judged. In estimating his success we must remember the limitations imposed upon him. Medical education in America was in a stage of development so different in his time from the present that it is difficult even for those of us who have witnessed its evolution to realize how crude and provincial it was. Our medical schools were mainly proprietary institutions conducted for financial profit. Laboratory facilities, clinical material, and individual instruction were either lacking altogether, as in the Department of Obstetrics, or were just beginning to be provided in the other two principal subjects of a medical course, medicine and surgery; but provided so inadequately that the student, obliged to go abroad to complete his education, could not justly be surprised at the contempt with which his medical diploma was regarded in Europe. The proprietors of our medical schools were quite satisfied that they had fulfilled their whole duty if they furnished a lecture room for a few hours a week to the teachers of the most important subjects in the course. The didactic lecture was the accepted method of medical teaching. Everything else was subordinate to it. These were the conditions in the very best of our schools, and it was under these conditions that Dr. Penrose was obliged to teach. The only means at his command to prepare his students for their future responsibilities was the didactic lecture. But of this means he availed himself with consummate ability.

Much as the undergraduate medical students admired his associates in a remarkable faculty, all of Dr. Penrose's old pupils will bear me out in the assertion that today, twenty years, at least, after they were given, we remember his lectures more distinctly than those of any of his colleagues.

Our present tendency is perhaps to neglect the didactic lecture too much. It can be utilized with advantage still. The teacher who desires to employ it would do well to study the methods of a

man like Penrose, who was obliged to concentrate all his ability on the only means of teaching at his command.

His personal dignity, penetrating but kindly voice, exquisitely keen sense of humor, poetic fancy, and eloquence were inimitable. But certain rules of the art might be learned by a study of Penrose's lectures. There was a delightful semblance of spontaneity about them, although they were really prepared as carefully as an actor studies his part. Emphasis, inflection, gesture, and expression were rehearsed beforehand. Flashes of humor and wit relieved the tedium of an hour's address. Each important point was brought out in bold relief, sometimes by a certain circumlocution in its introduction, often by an amusing anecdote, again by unexpected antitheses or apparent paradoxes, and occasionally by moving his audiences at one moment to roars of laughter and at the next to an awed silence.

It would be interesting to give an example of Dr. Penrose's ability as a lecturer, but, unfortunately, an examination of his papers after his death showed that almost all of his manuscript lectures had been destroyed. Even if it were possible to read an extract from one of them, I should fall so lamentably short in the qualities that made their delivery effective, that those who had not heard him would still be ignorant of his oratorical power and charm, and his old students who did hear him need not be reminded of the many pleasant and instructive hours they spent in his lecture room. Who can forget the account of all the essential scientific facts then known in regard to fertilization of the ovum, in the guise of a charming fairy tale in which the spermatozoön figured as the prince and the ovum as his captive lady love awaiting liberation from her enchanted cell, the Graafian follicle—a Psyche to be awakened by Cupid's kiss? or the lesson about the diagnosis and treatment of hydramnios introduced by a description of Penrose's first case, encountered at the dead of night, in a lonely house alongside a deserted graveyard? or the courtly manners, the wise advice and admonitions, the efficient assistance of her distinguished accoucheur to the immortal Mrs. O'Flaherty on the occasion of her annual accouchement in the lecture room?

Something more is required of Penrose's panegyrist than a mere analysis of his qualities as a medical teacher. Many Fellows of this College were his personal friends, and hold him in affectionate remembrance. Those who were not privileged to know and hear him can better understand his power and influence by some knowledge of the man himself. His oldest brother was described as the "amiable and kind Penrose." The description is equally applicable to the younger brother. He fairly radiated kindliness. A harsh, unkind, or ungenerous thought was absolutely foreign to his nature. He was affable, courteous, cordial to all degrees of men; but a conciousness of distinction in birth, connections, and position gave him an innate dignity which forbade undue familiarity or lack of respect.

His odd and whimsical views on men and things gave his conversation a fascinating piquancy. One of his amiable foibles was to consider his friends perfection itself. He could see no fault in them. His enthusiastic partisanship for people he liked reminds one of Essex endeavoring to secure the attorney-generalship for his friend Bacon, and saying to Sir Robert Cecil: "I will spend all my power, might, authority, and amity, and with tooth and nail, procure the same for him against whomsoever."

An incident in our association illustrates what I mean. He had determined to do all in his power to make me his successor. As the chief requisite in a medical teacher at that time was the ability to lecture to large classes of students, he told me to prepare a lecture as carefully as I could and to commit it to memory. When it was ready I was given a letter dated two days later, ostensibly received just before his lecture hour, and reading, "I am unexpectedly detained. Please inform the class. If they care to stop and listen to you, you may use my hour." I was instructed to enter the room in apparent confusion, making the open letter in my hand tremble; to mount the rostrum, and after giving the class Dr. Penrose's message, to say, in a hesitating voice, "If you are willing to stay and hear me, I have a word or two to say on an interesting subject." "They will stop to hear you," said Dr. Penrose, in the expectation of seeing you make an exhibition of

yourself." His little plot was carried out exactly as he had planned it. My lecture was well received, and Penrose was hugely delighted at its success.

I could give many more examples of characteristic kindnesses to younger men whom he befriended with a bounteous generosity that knew no stint.

As we all know, this kindly, courteous gentleman has recently passed away; but there is nothing melancholy in such a death as Penrose's. Retiring in the full possession of his faculties and in the enjoyment of an enviable reputation, at an age when there was no premature retreat from the battle of life to an inglorious ease, but when he had earned the right to repose; followed into his retirement by the affectionate regard of hundreds of pupils in all parts of the world; living a score of years in tranquillity and peace; exceeding the allotted span of life by more than a decade; surrounded by devoted friends and a loving family, with undimmed faculties and undiminished interest in the progress of his profession; exemplifying Cicero's declaration, "Senectus non impedit quominus literarum studia teneamus usque ad ultimum tempus senectutis:" there could be no more fitting end to an honorable career. What better fate could any of us ask when we leave this mortal ark behind and answer "Adsum" at our last roll call, than to have our survivors say of us, as we can say of our departed friend, "The sweetest canticle is nunc dimittis, when a man has obtained worthy ends and expectations."

ANNUAL ADDRESS OF THE PRESIDENT[1]

By JAMES TYSON, M.D., LL.D.

The year 1909 has been pregnant with events most of which have been recorded in the report of the dedication exercises, which will be published in the forthcoming Volume XXXI of the Transactions of the College. The successful completion of the New Hall, which we occupy this evening for the second time officially, is now a matter of history, and we may be said to be entering on a new era of the life of the College.

Death has not been very exacting of us during the past year. Dr. Richard A. F. Penrose died December 26, 1908, aged eighty-one years; Dr. Harry Godey, January 30, 1909, aged fifty-nine years; Dr. J. Alison Scott, August 13, aged forty-four; Dr. Henry C. Chapman, September 8, aged sixty-four; Dr. George C. Harlan, September 12, aged seventy-four; Dr. John J. Black, September 27, aged seventy-two; and Associate Fellow P. S. Conner, March 26, aged seventy years.

The Censors have directed memoirs to be prepared of Dr. Penrose, Dr. Scott, Dr. Chapman, and Dr. Harlan. Dr. Barton Cooke Hirst has agreed to read the memoir of Dr. Penrose, Dr. Alfred Stengel that of Dr. Scott, Dr. John B. Shober that of Dr. Harlan, and Dr. Albert P. Brubaker that of Dr. Chapman.

Dr. Godey became a Fellow in 1884. He was an accomplished and genial gentleman, a graduate of Harvard College and of the Jefferson Medical College. He never practised medicine, being possessed of an ample fortune.

[1] Read January 5, 1910.

Dr. John Janvier Black became a Fellow in 1866, and was therefore among our oldest members. He came of an eminent Delaware family, and was born in Delaware City. His father and grandfather were physicians before him. He was graduated from Princeton College in 1858 and from the Medical Department of the University of Pennsylvania in 1862. From November, 1862, to September, 1864, he served in the Medical Department of the United States Army during the Civil War. In October, 1864, he was elected a resident physician in the Philadelphia Hospital, and at the end of his year's service he began practice in Philadelphia on Thirteenth Street near Walnut. In 1866 he set out for Europe in a sailing vessel, which was wrecked, and he returned to New York, whence he again sailed on a steamer, landing at Havre, France. On his return from Europe, in 1867, he located in Newcastle, Delaware, where he acquired a large practice, and on account of his professional and scholarly attainments became easily the leading physician in his State. Besides numerous papers he published in 1890 a volume entitled *Forty Years in the Medical Profession*, and in 1906 a second entitled *Eating to Live*. Besides being in the front of all movements for the elevation of his profession and improvement of the health of his community and State, he was a man of affairs, having been at different times president of the bank, president of the Trustees of the Church, president of the Board of Commons, president of the library, surgeon to the Pennsylvania Railroad, and trustee of many estates. He was identified with the treatment of insanity and tuberculosis, and was associated with the construction and management of institutions for the treatment of both.

Dr. Phineas Sanborn Conner, of Cincinnati, Ohio, became an Associate Fellow of the College in 1896. He was professor of Surgery in the Dartmouth Medical School, New Hampshire, for twenty years prior to his death. A friend who was associated with him for fifteen years writes as follows:

"Honorable and honest to a fault in thought and action, he held in bitter contempt those who paraded virtue for appearance' sake.

"Conversant with all important topics of the day, and widely acquainted with all departments of literature, his companionship

was delightfully pleasing and instructive. In medical literature, current and past, he was a veritable encyclopedia; acquainted in remarkable detail with the history and achievements of all the great medical men of note from Galen to the present time. He possessed an accurate memory of dates and the succession of events, and thus he became a master of the history of medical and surgical science. Dr. Conner was a fluent speaker, a teacher of rare ability, and a surgeon who stood in the front rank of his day. His acquaintances and friends were many, both in this country and Europe; but those in whom he confided were few.

"He had a wholesome contempt for professional irregularities and trickery, and never hesitated to make his disapproval known in terms of emphatic severity."

The accessions to active Fellowship have been only eight, while seven resigned, two forfeited Fellowship, and six died, reducing the total active list to 436. Seven were elected to associate Fellowship and one Associate Fellow died, leaving forty-six Associate Fellows, of whom twenty-seven are American and nineteen are foreign. The roll of the College on December 1, 1909, included, therefore:

	1909	1908
Fellows	436	443
Associate Fellows (of whom 27 are American and 19 foreign)	46	40
Corresponding Members	4	4
Total	486	487

Or one less than on December 1, 1908.

Effort should be made to enlarge our membership by the addition of suitable Fellows. As I have said in one of my annual addresses, the most desirable Fellows are not those who actively seek membership. The best men are modest and will not push themselves. We must therefore seek them.

There are many Fellows connected with the different medical schools to whose teaching staffs we naturally look for eligible material, who if they will but take the trouble will be able to recall men who should be elected.

There is another class of eligibles that is overlooked. It includes well-educated practitioners past middle life, who have long prac-

tised in our city and suburban communities who may not have been authors or original investigators, but who are eminently respectable and are honored by their patients and fellow citizens. These men should be sought out and nominated for Fellowship by leading Fellows of the College who are themselves well known and whose indorsement will be received by the Council as sufficient to justify election, even if the candidate is not personally known to the members of that body.

Notwithstanding the disturbing effects of building and removal, a fair number of papers was read during the year, for the most part of improved quality. The following are some of them—up to December 1, 1909:

"Circumscribed Serous Spinal Meningitis," by William G. Spiller.

"Experimental Studies of the Pancreatic Reaction of Cammidge," by John Speese and Edward H. Goodman.

"A Report of Seventeen Cases of Epidemic Cerebrospinal Meningitis Treated with Flexner's Serum," by B. Franklin Royer.

"Pentosuria," by S. Solis Cohen.

"Clinical Notes on Ulcer of the Stomach," by John H. Musser.

"An Epidemic of a Cutaneous Disease of Unusual Character Due to a Minute Mite in Straw Mattresses," by J. E. Schamberg.

"The Diagnosis and Surgical Treatment of Acute Pancreatitis," by John B. Deaver.

This showing is, however, not what it should be. Now that we are housed in our new Hall, and are provided with an abundance of books and journals and conveniences for study and literary research, the aim of the Fellows should be to produce creditable papers which will enhance their own reputation and that of the College. The College is not a social club, membership to which excuses all further intellectual effort. I am not certain that it would not be desirable to require at intervals certain evidence of qualification by attendance or otherwise to justify continued fellowship.

Addresses by eminent men in the profession from other cities should be secured from time to time on subjects of general interest

stripped of technicalities, to which the public may be invited, and I am glad to say that steps are now on foot to secure a series of such lectures. In this way the attention of the public may be drawn to the College, and one of its important purposes, mentioned in the first constitution, namely, "appointing stated times for literary intercourse and communications," be accomplished.

In my dedicatory address I called attention to the fact that the College is not as frequently called upon for an expression of opinion on certain questions of popular weal as it was during the first twenty years of its existence. For this I gave what seemed to me sufficient reason. On the other hand, it is the duty of the College to express itself on important questions of hygiene and health, regardless of invitation, cautiously and on well-established grounds, but nothing should be undertaken which has not a reasonable prospect of success, since failure is apt to be associated with loss of influence.

Our library continues to grow. The total number of volumes added during the year, omitting duplicates, was 3448.

The number of volumes on December 1, 1909, was as follows:

	Bound.	Unbound.	Total.
General library	60,528	3,362	63,890
Lewis library	13,492	44	13,536
S. D. Gross	3,372	3	3,375
Obstet. Soc.	217		217
Total			81,018

There are also unbound Reports and Transactions, 8202; unbound Theses and Dissertations, 23,711; unbound Pamphlets, 70,213.

Total accessions, including 515 volumes "Reserves,"[1] 3448.

Some of the annual reports of our officers and committees might be made more interesting, some being too short, while others are too long. It is impossible, for example, for the average listener to follow the details of the Treasurer's debits and credits and the list of his investments. They may as well, therefore, be omitted from the read report, although they should appear in the printed report,

[1] Reserves are second copies of some more important periodicals and more or less incomplete.

as I ventured to suggest in an annual address two or three years ago. In like manner, the Library Committee should prepare a full report for publication covering a description of the state of the library and its funds, with suggestions as to methods of increasing its usefulness, which might be curtailed in the reading. These are examples which may be more or less imitated in other reports. The reports as read to the College should be a condensed statement of such of its affairs as can be understood by the Fellows and be of interest to them.

This is the last opportunity I shall have of addressing you from the chair. I cannot retire without expressing my thorough appreciation of the compliment implied in my election first as Vice-President, then as President of the College, and for the uniform courtesy which has been extended me as presiding officer. On every side I have met with consideration, and officers and committees alike have seemed to vie with each other in efforts to make my duties easy and agreeable. I feel that I have inadequately requited this consideration, but have done so as far as I could by such punctuality and regularity in attendance and watchfulness over the interests of the College as is justly due from the president of a society whose traditions are those of our College, which early became the leading society of the country, and the imitated of all subsequent organizations which aspired to importance and leadership. Its standard has not been lowered by the events of its recent history, and it stands today more conspicuous than at any time during its existence. This honorable prominence must be maintained. To this end, in addition to care in the selection of Fellows and maintaining a high standard of publications, the material wealth of the College should be fostered. No opportunity should be lost by Fellows to draw the attention of patients and others to its wants. We not only need endowment and special funds to maintain the library and the running expenses of the College, but also to widen its sphere of usefulness. We need the adjoining property, not only for the sake of enlarging and beautifying our own, but also to give us an opportunity to extend our Hall by adding a laboratory where research work and clinical and bacteriological examinations may

be carried out under the auspices of the College and by which our Fellows may especially profit.

In this and many other ways may the usefulness of the College be increased if the means for such purpose be at hand. Directly or indirectly such means must be supplied by the Fellows, and at the end of every year each Fellow should ask the question, Have I done what I might to further its interests, or is there not some way in which I may show my loyalty to it? Fruit from such seed may seem remote and unlikely, but with repetition and the lapse of time it may drop long mellowed when least expected, like bread cast upon the waters.

CHRONIC PANCREATITIS *

By JOSEPH SAILER, M.D.

Chronic pancreatitis was carefully described by Fitz[1] in 1887. He even described most of the varieties, and I believe it fair to say, was not less familiar with the symptomatology than we are at the present day. The condition slumbered somewhat peacefully after Fitz's paper, but of late years, very largely owing to the persistent efforts of Mayo Robson[2] and the enthusiasm of the surgeons for new fields of endeavor, it has begun to arouse widespread interest.

Our knowledge of chronic pancreatitis, at least as far as its morbid anatomy is concerned, is in a reasonably satisfactory condition. The ordinary form, as in all other forms of chronic inflammation, consists of degenerative changes in the cells, and proliferation of the connective tissue associated with round-cell infiltration. The etiology of this condition may vary. Among the known causes are obstruction of the pancreatic duct or ducts, which may be produced by lodgement of a gallstone in the ampulla, first described by Opie;[3] or the presence of calculi in the ducts, commonly composed of calcium carbonate, which are in all cases associated with more or less focal and sometimes with general sclerosis of the pancreas; or the infection, if it may so be called, of the pancreatic tissue by the route of adhesions to tissues in its immediate neighborhood; or possibly by the existence of certain general infectious diseases as the type of chronic pancreatitis described in newborn children suffering from hereditary syphilis.

* Read January 5, 1910.

Cysts of the pancreas are also commonly associated with more or less extensive sclerotic changes, and it is possibly the rule rather than the exception, that after attacks of acute pancreatitis, chronic pancreatitis is apt to develop, as in a case recently reported by Glaessner,[4] which was followed for a year and found to have developed an alimentary glycosuria and a diminished amount of trypsin in the stools. Similar cases have previously been reported. There is also a type of chronic pancreatitis, first described by Scobolew,[5] characterized by the disappearance of the Islands of Langerhans and associated particularly with the severer forms of diabetes. If we attempt, however, to discuss chronic pancreatitis from a clinical standpoint, we find that it is in a deplorable state at the present time. Various observers, particularly surgeons,[6] following the lead of Mayo Robson, have insisted that it is a common condition; but the majority of medical men, even those who have had their attention particularly directed to the subject, have been unable to confirm this statement, and a considerable degree of willingness to diagnosticate morbid conditions of the pancreas has not led to the discovery of any large proportion of patients in whom even a reasonable suspicion of their existence seemed to be justifiable. One need only read the three pages devoted to the symptomatology in the recent work of Robson and Cammidge,[7] to realize how indefinite the picture is at the present time. Practically the symptoms resolve themselves into (*a*) some discomfort apparently associated with the stomach, (*b*) evidence of indigestion, (*c*) pain of any degree or variety, sometimes in the neighborhood of the umbilicus and sometimes elsewhere in the abdomen, and, as more definite signs but only occasional, (*d*) jaundice, (*e*) a distended gall-bladder, and (*f*) a more or less evident mass in the region of the umbilicus that can be differentiated occasionally from the stomach. In addition to these indefinite signs, there are a number of laboratory tests, concerning the accuracy of which there is much difference of opinion depending largely upon the enthusiasm of the investigator who has studied them.

Basing my remarks rather upon a study of the literature than

upon many personal observations, I am inclined to think that we can classify cases of chronic pancreatitis into three clinical types. The first type may be represented by the group of cases in which, either as a cause or as a complication of the sclerosis, there is obstruction of the duct of Wirsung and the common bile duct. Among these cases are the instances of lodgement of a gallstone in the ampulla of Vater. These cases are all characterized by jaundice, sometimes also by distention of the gallbladder producing a palpable tumor, emaciation, digestive disturbance and the various changes in the secretions and discharges available for examination, that indicate deficient functional activity of the pancreas. If in addition there is a history of gallstone colic and a palpable mass in the region of the umbilicus which may also be tender, it would seem that a correct diagnosis should be reached. The second type includes cases in which the swelling of the head of the pancreas is so great that a palpable tumor is present. There may also be jaundice, which frequently is of the most intense character, and the other symptoms that have been described. I do not believe, however, that the diagnosis can be made with certainty, because until the operation, and in many cases even afterward,[8] there will be doubt whether the case is one of carcinoma of the pancreas or merely a chronic pancreatitis. The third type includes the group of cases and presumably much the larger group in which there is neither jaundice nor a palpable mass. At the present time, the diagnosis of these cases is exceedingly indefinite and uncertain, and is made either by the surgeon at the time of the abdominal operation by feeling the increased hardness of the gland, or by the clinician as a result of a careful study of all the possibilities, the exclusion of those morbid conditions which might reasonably be suspected, but are not present, and a careful correlation of the symptoms, signs, and laboratory tests that may indicate or suggest impaired functional activity of the gland.

The symptomatology of these forms may be given as follows: Nutrition is almost invariably impaired, and the patient is emaciated, sometimes to an extreme degree. Digestion is dis-

turbed. There is discomfort after eating, and often this discomfort can be associated with certain articles of food, particularly the carbohydrates. The discomfort does not appear to have any characteristic type. It may be a sense of oppression, or of fulness, or actual pain. Vomiting occurs quite constantly, but it may be only at long intervals. It rarely occurs immediately after taking food unless the condition of the patient is very grave, but may occur in the morning or some hours after taking food, and is usually preceded by a period of discomfort. Constipation is the rule. Occasionally there are attacks of diarrhea, but chronic diarrhea does not appear to occur.

The main factor in the diagnosis is the recognition by some chemical or other test of the insufficiency of the pancreatic secretion. These tests may be divided into the following groups: (1) Those showing disturbances of the internal secretion of the pancreas if such a secretion exists at all. (2) Those which have to do with the recognition of the existence in the stomach or intestinal contents, of some of the pancreatic ferments. When they can be demonstrated it is assumed that the pancreas is still functionally active. (3) Those which indicate whether the pancreatic ferments have been discharged into the intestinal tract and have properly digested the food material that has been brought to them. (4) Those which show a disturbance of the carbohydrate metabolism.

Under the first group belongs the dilatation of the pupil after the instillation of adrenalin. This was first suggested by Loewi[9] as a clinical test, although it had been used in the physiological laboratory (Ehrmann and Meltzer) for some time previously. Personally, I have tested it a number of times, and in the two cases I shall report tonight it was negative. It was distinctly positive in one case of pernicious anemia, but no autopsy was obtained in this case. The Cammidge reaction was negative and there was no particular reason to suppose that the man had chronic pancreatitis or suppression of the functional activity of the pancreas, although it is entirely possible. In a number of doubtful cases it was also negative, so that among some thirty

tests, I have obtained it only once. It is of exceedingly doubtful value.

The second group is more interesting. Volhard[10] following the lead of the physiologist, Boldireff[10] has attempted to obtain regurgitation of the duodenal contents into the stomach by the administration of large quantities of oil. The duodenal contents are then separated and tested for the presence of trypsin by various methods somewhat more delicate than those commonly employed. The entire literature on this subject has been reported by Farr,[10] together with an elaborate series of experiments. The method is a little difficult, but its difficulties are not prohibitive. The results at present are not sufficiently conclusive or constant for us to base any definite diagnosis upon them.

Laquer's[11] method depends upon the recognition of trypsin in the feces. Small portions of the feces are spread upon a Petri dish containing a layer of coagulated serum or albumin and then kept at 55° C. If a depression appears upon the albumin, it is regarded as an evidence of the presence of tryptic ferment. Various other methods have been devised for the purpose of obtaining the duodenal contents, but none are of any clinical value.

The fat-splitting ferment has also been sought in the feces, and Opie[12] claims to have found it once in the urine.

The third group of tests is somewhat less satisfactory. Those tests which involve the passage of some substance through the stomach and its solution in the intestines only if the pancreatic secretion is active, are so exceedingly uncertain that they may be dismissed merely with a mention. They include the administration of a substance that can be recognized in the urine or saliva, such as methylene blue, which stains the urine or of carmine which stains the feces; of an iodide, which can be recognized chemically in the urine or saliva, or of a salicylate which can be recognized chemically in the urine. These are administered in such a manner that they cannot be dissolved in the stomach and presumably only by the active pancreatic juice, the principal enclosures being the glutoid capsule and the salol coated pill. I believe it is perfectly safe to assert that no definite conclusions

can be drawn either from a positive or negative result of any of these methods.

At one time, it was supposed that the digestion of the nuclei in the muscle fibers suggested by Schmidt[13] was a fairly good test of pancreatic activity. The late Dr. Steele[13] spent much time and effort in the study of this reaction, and ultimately reached the conclusion that it was of little if any value.

The presence of an excess of neutral fat in the feces (steaborrhea), is also of uncertain value. The table furnished by Cammidge[7] in his work is sufficient proof of this statement. The presence of a large amount of undigested starch or of undigested meat fiber (azotorrhea) is also of little value. Somewhat less direct than these laboratory methods is the inability of the patient to take large quantities of carbohydrates without suffering a considerable amount of discomfort.

The fourth group comprises the various disturbances of the carbohydrate metabolism. The presence of sugar in the urine in the severer forms of chronic pancreatitis appears to be quite common. The presence of alimentary glycosuria, that is, the appearance of sugar in the urine after the administration of 100 grams of glucose, a rather disagreeable dose, appears also to be common, and is a test that should, I believe, be more frequently employed.

The Cammidge reaction.[7] The statements regarding this are so contradictory and confusing that it is impossible for one who has not done it personally to reach any definite conclusions. It is a reaction very difficult to perform, and, indeed, there have been some who believe that it is not a reaction at all, but merely the result of the different procedures that are necessary in its performance. Even assuming that a reaction exists, there is, I believe, no doubt at the present day that it is not positive but merely suggestive, occurring in many other conditions,[14] particularly achylia gastrica and pernicious anemia.

The treatment of chronic pancreatitis is much disputed.

The surgeons have assumed that they only are capable of

producing any beneficial results. In other words, that there is no medical treatment.

The surgical treatment consists of draining the biliary passages in order that the pancreatic secretions if they do not get into the duodenum, at least do not injure the pancreas by their retention, and of freeing the pancreas of any adhesions that might disturb its functional activity. It is difficult to understand how either measure could favorably affect an advanced sclerosis, but there is no doubt that even when the proliferation of the connective tissue has been so great that the large head of the pancreas has been mistaken for carcinoma,[8] the separation of the adhesions or even sometimes merely an exploratory operation has brought about great relief.

The medical treatment is symptomatic and specific. The symptomatic treatment consists exclusively in the improvement of digestion. The gastric contents should be studied and restored, if possible, to approximately their normal reaction. Food should be easily digestible. It may be necessary to give a diet similar to that used in diabetes, and constipation should be combated by laxatives or enemata.[15]

The specific treatment consists in the administration of substances designed to supply the missing or defective pancreatic secretion. Carnot[15] is so confident of the efficiency of this therapy that he regards failure to improve after its administration as evidence of the non-involvement of the pancreas. These substances are all preparations of the gland itself, and it must be remembered that the preparations of different makers vary extraordinarily in efficiency. Some of the so-called extracts of pancreas, pancreatin, trypsin, etc., are practically inert, and none of them have a proteolytic activity comparable to that of scale pepsin. All the commercial preparations, moreover, are contaminated with bacteria, chiefly Bacterium coli. They must, moreover, be administered in such a manner that they are not destroyed by the gastric secretion, because as soon as the pancreatic secretion is brought in contact with the gastric secretion, its activity is permanently lost, For this reason, they are given in very

much the same way as various test substances; that is to say, either in salol-coated pills or glutoid capsules. The salol-coated pills are objectionable because they are very large and very hard to swallow, and leave a painful sensation in the esophagus persisting for several hours. The glutoid capsules, on the other hand, are similar in size and ease of swallowing to the ordinary capsule. After a little experimentation I devised a method of preparing the glutoid capsule which is very simple and apparently efficient. The ordinary gelatin capsule was employed, and as soon as it was filled a camel's-hair brush dipped in melted gelatin or hot water was passed around the line of union of the two parts. As soon as this dried, the capsule was immersed in pure formalin for three minutes, again dried, and then thoroughly washed. Such a capsule filled with carmine stains the feces if given twenty hours before the movement, but it will remain in gastric juice in an incubator for twenty-four hours without showing any signs of softening.

Mrs. S., aged fifty-four years. Had complained of severe indigestion for over a year. The symptoms were pain, often very severe, two hours after eating, eructation, regurgitation of food, and occasional vomiting. There was a feeling of weight in the abdomen, and the bowels moved only with laxatives. Twenty years ago she had a series of attacks lasting for a period of three or four months. They occurred about once a month and consisted of a gradually increasing pain which ultimately required morphine. The duration usually was two or three hours. Two years ago the climacterium occurred. For the last ten months there have been occasional attacks of severe pain, colicky in character in the region of the umbilicus during which she is compelled to lie down and draw up the legs and occasionally to induce vomiting. She has noted that any indulgence in starchy foods or sugars is followed by severe pain in the abdomen. The interesting features of the examination were a sense of resistance just above the umbilicus, marked tenderness upon pressure from the umbilicus to the xiphoid, and a spot of extreme tenderness one inch above the umbilicus and one inch to the right of the median line that sometimes disappeared if during the pressure the patient took a deep inspiration. The right kidney was in the second position and freely movable. The blood was normal. The stomach contents showed a moderate reduction of the total acidity and plenty of free hydrochloric acid. The urine was negative to the ordinary tests and particularly did not contain

albumin or sugar. Her weight was one hundred and seventeen pounds, and she was five feet seven inches tall. The character of the pain simulating so exactly gallstone colic, the tenderness over the position usually occupied by the head of the pancreas and the absence of tenderness over the gall-bladder led to the suspicion of pancreatic calculus. Dr. Pancoast made two plates, on both of which a small circumscribed shadow was found resembling that of a renal calculus in the supposed situation of the head of the pancreas. He did not think it could have been a calculus of the kidney, gall-bladder, or gall-ducts because of the situation. Dr. Goodman examined the urine for the Cammidge reaction which was positive and the stools for neutral fat which was normal. A single test for alimentary glycosuria was positive. The patient suffered greatly after taking the glucose. The Loewi pupillary test was negative. The patient was placed upon five grains of extract of pancreatic gland in glutoid capsules one after each meal. Before this was done her weight had gone down to one hundred and thirteen and one-half pounds. From that time the progress was almost uninterrupted. There were a few attacks of pain, but she gained from one to two pounds per week and now weighs one hundred and forty-eight pounds in about the same clothing that she wore when she first came to my office. She suffers practically no discomfort and is exceedingly active in social and philanthropic work. No other treatment excepting a brief course of massage has been employed. She has not rested or restricted her diet, and, of course, she is able to eat much more than before beginning the treatment.

Mrs. M. H., aged thirty-five years, white. Previous history: In early adult life she had an ischiorectal abscess cured by operation. At the age of twenty-nine years, blood was occasionally observed in the stools. At the age of thirty-one, there was an attack of severe pain in the abdomen with vomiting. An operation was performed and an incision was made about three inches long on the right side of the abdomen. The surgeon reports that the examination showed only enlargement and hardening of the pancreas and the incision was closed. Four weeks before admission, that is, four years later, a fistula formed in this incision from which fecal matter and bloody mucus was discharged from time to time. The patient had much pain in the abdomen. The appetite was lost and there was nausea and vomiting of practically everything. She could sleep only under the influence of morphine. At this time she was under the care of Dr. William Evans, with whom I saw her in consultation. He suggested that she be admitted to the Presbyterian Hospital on the service of Dr. H. R. Wharton. The examination showed some resistance just above the umbilicus, but no definite mass, and considerable induration in the right lower quadrant around the sinus. There was considerable tenderness in this region and diffuse tenderness over the lower portion of the abdomen. The patient was extremely

emaciated and pale. There was a loud systolic murmur at the pulmonic cartilage. After admission to the hospital, the urine was examined and found to contain sugar and Dr. Goodman reported that the Cammidge test was intensely positive. The patient was, therefore, given extract of pancreas in glutoid capsules. She improved very rapidly. The fistula closed, reopened, and again closed apparently permanently. The sugar disappeared from the urine, and fifteen days after her admission the report was practically negative. A second Cammidge test, however, was not done. On admission, the red blood cells were 2,930,000. Her weight on August 28 was eighty-five and one-half pounds, and on September 8 it was ninety-six pounds. At this time she was up and about the ward taking a regular house diet, seemed strong, and felt very well. She said that when she omitted the capsules on one occasion for two days, she felt very uncomfortable in the abdomen and her nausea returned. She was discharged on October 16, eleven weeks after her admission, practically well. I have since heard from Dr. Evans that she discontinued taking the capsules, but that her condition remained satisfactory.

Although the results in these two cases have been apparently excellent, I have endeavored to keep clearly in mind the fact that no definite conclusions can be based upon two cases and that the improvement may have been independent of the treatment. I cannot understand how the administration of the extract of the pancreas, which at most can be regarded merely as a substitute for the pancreatic secretion, could bring about any improvement in the actual condition of the pancreas itself, and therefore, I do not know why both patients have been able to discontinue the use of the capsules without any apparent tendency to relapse, neither do I understand why such a small amount of the extract of pancreas with its low proteolytic activity and, its very moderate starch digestive power should so completely substitute for the supposed indispensable pancreatic ferments that the patients are able rapidly to increase in weight and strength. It is conceivable that there are other factors involved, possibly ferments or neutralizing bodies, of whose existence we are at most suspicious, but to assume their existence in order to explain our results is simply piling theory upon theory. At best, therefore, we can only conclude that in the present instances the adminis-

tration of extract of pancreas appears to have improved the patients and that its use at the present time must be largely empirical, although there is a possibility of a certain degree of substitution taking place.

Recently an acute intestinal obstruction due to an incarcerated hernia, made it necessary to open the abdominal cavity of the second patient again. The desperate condition of the patient precluded any thorough examination, but the surgeon noted that the gall-bladder was distended and he was uncertain about the size and hardness of the head of the pancreas. The patient made a good recovery and it is possible that later a cholecystenterostomy will be considered.

BIBLIOGRAPHY

1. Fitz. New York Med. Rec., 1890, xxxv, 197.

2. Mayo Robson. Hunterian Lecture, 1904; Truhart, Pancreas Pathoolgie, Wiesbaden, 1908; Leven, Jour. Med. Research, 1907; Guleke, Archiv f. klin. Chir., lxxviii, 845; Martina, Deut. Zeit. Chir., 1907, lxxxvii; Walko, Münch. med. Woch., 1907, 1460; Dieulafoy, Presse Médicale, 1907, No. 83.

3. Opie. Johns Hopkins Med. Bull., 1901, vii, 397; Diseases of the Pancreas, 1903.

4. Albrecht. Wien. klin. Woch., 1909, No. 43.

5. Scobolew. Centralbl. f. Allg. Path. u path. Anat., 1900, ii, 204; Ohlmacher, Amer. Jour. Med. Sci., 1904, cxxviii, 287.

6. Deaver Trans. Coll. Phys. of Phila., 1909; Mayo, Jour. Amer. Med. Assoc., April 11, 1908.

7. Robson and Cammidge. The Pancreas, its Surgery and Pathology, Philadelphia, 1907; Brugsch, Zeit. f. klin. Med., 1906, lvii; Schneider, Münch. med. Woch., 1907, No. 13; Walko, Archiv. f. Verdauung., 1907, xiii; Mayo Robson, Berl. klin. Woch., 1908, Nos. 4 and 7.

8. Glaessner. Deut. med. Woch., 1903, No. 15.

9. Loewi. Münch. med. Woch., 1907, p. 1411; Bard, Archiv d. Mal. de L'App deigest. et de la Nut., 1908, ii.

10. Volhard. Münch. med. Woch., 1907, p. 403; Boldireff, Archiv f. d. ges. Phys., cxxi, 13; Zentralbl. f. ges. Phys. und Path. des Stoff., 1908, No. 3, p. 209; Farr, Jour. Amer. Med. Assoc., 1910.

11. Laquer. Berl. klin. Woch., 1909, No. 19.

12. Opie. Diseases of the Pancreas, 1903.

13. Steele. Univ. of Penna. Med. Bull., November, 1906; Schmidt, Archiv klin. Med., lxxxvii, 456.

14. Kreinitz. Archiv f. Verdauung., 1909, xv, 53; Speese and Goodman, Trans. Coll. Phys. of Phila., 1908, xxx, 167; Eloesser, Mitt. a. d. Grenzgeb. d. Med. u. Chir., 1907, xviii, Heft 2.

15. Carnot. Mal. du. Pancreas, Paris, 1907; Wohlgemuth, Münch. med. Woch., 1907, p. 147; Fischer and Hoppe, Münch. med. Woch., December, 1907; Bense, Orvise Hetilap, 1907, p. 726 (abstract Zentralbl. d. ges. Stoffw., 1908); Myers, Zeit. f. Exper. Path. u. Ther., iii, 580.

DISCUSSION

Dr. John B. Deaver: With Dr. Sailer I agree that the diagnosis is a difficult one and in many instances very uncertain. That chronic pancreatitis is a more common affection than I think we are led to believe has been fully demonstrated by the surgeon. As Dr. Sailer was reading, I thought what a pity that the physician has not the opportunity of passing his hand into the abdomen and feeling the pancreas as has the surgeon. There is always an uncertainty, too, on the part of the surgeon who feels the pancreas whether or not there is an interstitial pancreatisis, and he often feels that he would like to have a section for microscopic report. The symptomatology is obscure. From reviewing the history and from operation, I have learned that we can frame a symptomatology, though it is not perfectly satisfactory. We have the symptoms of indigestion in the absence of gall-bladder disease, latent gastric or duodenal ulcer, with intermittent though slight jaundice, loss of weight and disposition to loose bowels. I have seen these patients relieved by the establishment of a communication between the gall-bladder and the duodenum. Drainage of the gall-bladder is not decided enough because the fistula closes too soon.

Dr. Musser will recall a case in which I think his diagnosis was perhaps the same as mine. We thought the woman had stone in the common duct. She had extensive adhesions of the upper abdomen. I opened the common duct and proved very conclusively that no stone was present. There was enlargement of the head of the pancreas. There was the characteristic feel which all surgeons who manipulate this part of the body meet so frequently. It is too soon to say whether this patient is cured, but from her own expressions of her feelings she is well. I have operated on a number and with equally good results.

In another case, one of diabetic pancreatitis, a case of which Dr. Tyson has some knowledge, the woman had gone the rounds and appeared in my clinic. There was 8 or 10 per cent. of sugar present. I operated for interstitial pancreatitis, the sugar disappeared, and the woman remained well for a year or two.

I am very pleased to hear Dr. Sailer's favorable reports in these two cases treated medically.

It is important to differentiate between carcinoma of the head of the pancreas and interstitial pancreatitis. In a number of these cases I have operated and tabulated them carcinomatous pancreatitis and the patients have reported well a year or two afterward. The symptomatology is not at all clear, and it requires very careful study both at the operating table and from the standpoint of the laboratory.

I am entirely dependent upon Dr. Goodman with reference to the Cammidge reaction. In the majority of cases which he has studied for me he has found this reaction. I believe it is of much moment if the study is made by a careful man.

Dr. John H. Musser: I feel that one cannot take issue with Dr. Sailer. He has presented in a most conservative manner the symptom-complex of chronic pancreatitis and has led us to believe that which most of us do already, that the diagnosis is a matter of extreme difficulty, and must be based upon a few general symptoms. With those mentioned by Dr. Deaver may be included chronic pigmentation of the skin. There should be a careful study of intestinal disturbances and a grouping together of various laboratory findings, not one of which is significant in one examination, but taken over a considerable period of time is of value. From time to time in persons apparently healthy there may be the Cammidge reaction. Usually the long-continued observation will show a rather definite and persistent finding from the laboratory standpoint. The gross characteristics of the stools are of more or less significance. The microscopic appearances are of undoubted value. In the consideration of general symptoms the occurrence of a recurrent anemia is important. Long observation is necessary; to make a diagnosis at once is simply a happy guess, and even with such observation diagnosis is sometimes impossible.

Regarding the medical treatment, I should, with Dr. Sailer, lay more stress upon the management of the gastro-intestinal tract than upon any other method employed, with management of the general health of the individual—indirect therapeutics, rather than any specific or direct methods, as attention to those organs and an increase of the functional activity of other organs which are not the seat of the disease. I am glad to hear of Dr. Sailer's success with the extract of pancreas and shall use it whenever the opportunity arises.

Dr. Sailer, closing: I agree with Dr. Deaver that in the first case reported the diagnosis must remain doubtful. At the same time, the improvement upon the treatment instituted impressed me very much, naturally much more than I could make it impress anyone else by merely recounting the result. Whether pancreatic calculi which are usually small rather than large and are nearly always multiple, can be recognized by the *x*-ray, I do not know. I think that is the first case in which it was ever attempted and the shadow was fairly distinct. There was no jaundice or history of jaundice in either case. I inquired very carefully in both and in neither was there any pigmentation. I am sure it could not have escaped my observation. In one case the blood was normal and in the other profound anemia was present, with the history of prolonged hemorrhage from the bowel and subsequently from the sinus, so that in that case the existence of anemia did not help us. As Dr. Musser says, it is not so much a pathognomonic symptom or group

of symptoms, but rather the grouping of all the facts that can be brought to bear that seems to make the diagnosis possible. I have tried to make a clear distinction between those cases in which there is distinct obstruction of the bile passages with induration of the head of the pancreas, and in which I believe the diagnosis ought to be more readily suspected, and those cases in which there is palpable tumor at the head on the one hand, and on the other, the large group of cases of chronic pancreatitis in which none of these definite signs exist.

A CLINICAL STUDY OF THE CAMMIDGE REACTION IN THE URINE*

By JOHN M. SWAN, M.D.
MEDICAL DIRECTOR, THE GLEN SPRINGS, WATKINS, N. Y.
AND
JOHN J. GILBRIDE, A.M., M.D.
INSTRUCTOR IN DISEASES OF THE STOMACH AND INTESTINES, PHILADELPHIA POLYCLINIC AND COLLEGE FOR GRADUATES IN MEDICINE.

(From the Polyclinic Laboratories)

The reaction known as the Cammidge reaction, which consists in obtaining crystals of a certain type in the urine after boiling with hydrochloric acid and treatment with phenylhydrazine hydrochloride, was introduced to the profession by Cammidge[1] in 1904. Two manipulations were then described, designated the A reaction and the B reaction, respectively. The technique of the test was further modified in 1906 by Cammidge,[17] and a method introduced known as the C reaction. This new method, by the addition of precipitation with tribasic lead acetate, is supposed to remove glycuronic acid from the material under treatment, so that the crystals produced by the reaction between the carbohydrate and the phenylhydrazine hydrochloride would not be mixed with the phenylhydrazine compound of that acid. Cammidge at first thought that the crystals which he obtained were crystals of glycerosazone. Subsequent study showed this opinion to be erroneous, and he next advanced the view that they were crystals of a pentosazone, and that the pentose was formed by boiling with hydrochloric acid from some "antecedent substance" in the urine.[2]

* Read February 2, 1910.

Willcox[13] is of the opinion that normal urine contains some substance—a polysaccharose or glycoproteid, perhaps—which itself gives no characteristic crystals with phenylhydrazine hydrochloride, but which, after hydrolysis, always yields a substance (probably a sugar), which latter substance gives very characteristic crystals with phenylhydrazine hydrochloride.

Kellas and Wethered[19] have also concluded, after an exhaustive review of a large amount of published work on the subject, that sugar is a normal constituent of the urine.

Eloesser[12] suggests that the crystals may be the result of the direct breaking down of the pentose containing nucleoproteids of the pancreatic tissue or to a change in the composition of the urine brought about either directly by the derivatives of liberated glycerin or indirectly by changes in metabolism due to the glycerin.

Haldane[21] suggests that they are produced by the inversion into a true sugar of some carbohydrate, such as dextrose or animal gum already existing in the urine.

Ham and Cleland[22] believe that the crystals are produced by the action of the basic lead acetate on phenylhydrazine hydrochloride and concentration of the fluid.

The Cammidge reaction has been shown to be present in the urine of patients suffering from disease of the pancreas, as determined by clinical methods and proved at operation or at autopsy by Schroeder,[3] Watson,[4] Eloesser,[12] Goodman,[6 7] Caro and Wörner,[11] Fiorro and Zambelli,[16] Kinnicutt,[18] Gruner,[23] Haldane,[21] and Schmidt.[25]

Bushnell[15] has reported a case of interlobular fibrosis of the pancreas without the reaction, and other observers have recorded cases diagnosticated pancreatic disease in which the reaction has been absent. Kinnicutt[18] has reported a case in which an acute suppurative peripancreatitis was associated with cholecystitis and cholelithiasis in which the reaction was negative. Gruner[23] has reported two cases of carcinoma of the pancreas in which the reaction was negative.

The reaction has been found in numerous other diseases: Carcinoma of the stomach, cholelithiasis, catarrhal jaundice, and

tuberculosis of the peritoneum, by Schroeder;[3] constipation, heart disease, kidney disease, disease of the liver, gall-bladder disease, colitis, gout, arteriosclerosis, alcoholism, malaria, pneumonia, pregnancy, tuberculosis, gastric ulcer, exophthalmic goitre and carcinoma of the stomach, by Watson;[4] mumps, by Edgecombe;[5] gastroptosis, cholelithiasis, intestinal obstruction, and diabetes mellitus, by Goodman;[6 7] cholelithiasis, carcinoma of the stomach, with metastasis to the liver, retroperitoneal sarcoma, and occluding carcinoma of the bile ducts, by Eloesser;[12] carcinoma of the stomach and cholelithiasis, by Willcox;[13] cholelithiasis, cholecystitis, and diabetes, by Kinnicutt;[18] severe abdominal contusions, epidemic colitis, diabetes, cholelithiasis, acute septic poisoning, and parametritis, by Taylor;[24] cholelithiasis, diabetes, and normal urine, by Haldane;[21] cholelithiasis, chronic bronchitis, carcinoma of the bile ducts, and diabetes, by Gruner.[23]

In Edgecombe's case of mumps[8] the reaction was done by Cammidge himself and was considered by him to indicate metastatic pancreatitis.

Schmidt[25] has found positive reactions in other diseases than pancreatitis.

It should be stated that in many of the reported cases in which the reaction was positive, the diagnosis was confirmed neither by operation nor at autopsy.

Speese and Goodman,[8 9] Eichler,[10] and Schmidt[25] have shown that the Cammidge reaction occurs in the urine of dogs in which pancreatic lesions have been produced experimentally.

Eloesser[12] has obtained the reaction in the urine of dogs after the intraperitoneal injection of glycerin.

Our interest in this test was aroused by the following cases, which occurred in the practice of one of us:

Case I.—A white male, aged thirty-six years, went to the Philippine Islands in March, 1904, and remained there until September, 1906. While in the archipelago he had an attack of dengue and two attacks of abdominal pain, one of which lasted two days, the other of which lasted one day. These attacks were not accompanied by diarrhea or vomiting. The second attack was accompanied by enlargement of both the liver and the spleen. Just

before he left Manila for San Francisco he had an attack of chill, fever, and sweat, and he had a similar attack after reaching San Francisco. With the former attack he had a well-marked eruption of herpes labialis. During his residence in the East he had a sore mouth, and a physician made a diagnosis of syphilis and treated him for a time with mercury.

When he was first seen by us (May 28, 1907) he complained of an "ache" in his right side in the region of his liver, which began in January, 1907. The pain had increased in severity. He had lost twenty pounds in weight. He felt feverish, but had no sweats, no chills, no dyspnea, no palpitation of the heart on exertion, no vertigo, no vomiting. He had occasional attacks of pain in the left side and some flatus of an offensive odor. He was having five putty-colored stools daily, large in quantity, but not watery. The stools at times were dark in color. His appetite was good, he slept well, but his temper was becoming more and more irritable.

An examination showed a slight prolongation of the expiratory murmur at the posterior portion of the right apex; an accentuated pulmonary diastolic sound; liver dulness from the fifth rib to the costal margin, edge distinctly palpable on deep inspiration; splenic dulness from the eighth rib to the costal margin, edge not palpable. No areas of tenderness or tumors in the abdomen, except the tender area in the region of the gall-bladder. The cervical and inguinal lymph nodes were palpable. The throat was red, but there were no ulcers. The tongue was coated, but there was no sore mouth. The blood showed 6,190,000 erythrocytes, 8560 leukocytes, ratio 1 to 723+, 100 per cent. hemoglobin (Fleischl), color index 0.80+. The differential count showed 46.2 per cent. polymorphonuclear neutrophiles, 26.2 per cent. lymphocytes, 19 per cent. large mononuclears, 4 per cent. transitionals, and 4.6 per cent. eosinophiles. The erythrocytes were normal in appearance and no malarial parasites were found. The urine was amber, acid; had a specific gravity of 1.025; contained neither albumin nor glucose; it had a slight cloudy sediment, composed of calcium oxalate crystals and cylindroids. The feces contained neither ova, adult parasites, embryos, nor protozoa. The patient said that he had been told by a physician that he should have his "gall-bladder scraped;" but that when he presented himself to a surgeon for the operation the surgeon laughed and refused to operate, saying that there was nothing to indicate an operation. On account of the passage of large, putty-colored stools, the loss of weight, and the former attack of sore mouth, a diagnosis of incomplete sprue was made, and the patient was put on a sprue diet—milk, four pints a day, increasing to six pints a day. He adhered to this diet for six weeks, during which time he improved in general condition; but the pain continued. The improvement consisted of a reduction of the number of stools from five to one or two a day, of medium size, formed, and without fermentation, a diminution of the distention and of the passage of gas by mouth

and by rectum, and of a cleaner appearance of the tongue. A serous hydrocele then developed, which was tapped, and which was promptly cured. A search for filaria embryos in the peripheral blood at this time gave negative results both on day and night examinations. The pains persisted, and an exploratory operation was advised. The patient was an officer in the United States Marine Corps, and, wishing to have his case properly on record, he went to the United States Naval Hospital in Washington. There an examination of his urine gave a positive Cammidge reaction, and the gall-bladder was opened and drained by Surgeon H. W. Curl. At the operation the head of the pancreas was found to be quite hard; no gallstones were found. Nine days after the operation the Cammidge reaction had disappeared from his urine.

Case II.—About one year later one of us saw a white male, aged thirty-two years, who complained of paroxysmal pain in the umbilical region, which was accompanied by vomiting. This patient went to the Philippines in 1899. About three months after reaching the Philippines he had an attack of typhoid fever, which was followed by chronic gastritis, the two conditions lasting altogether for six months. He had three attacks of diarrhea while in the Philippines, but none sufficiently severe to require him to leave off his customary occupation. He did not have dysentery, neither did he have malaria. The abdominal pains began in 1906. At first the attacks came on once in six weeks or two months and lasted for a day or two. The pain began in the right side of the umbilical region, and was preceded by a swelling and "hardening" of the abdomen, and was followed by vomiting. The pains were paroxysmal, two or three attacks being experienced in two days, but they did not radiate. The attacks gradually increased in frequency until, at the time the patient was first seen, he was having them daily. The majority of the attacks were mild, but twice a week they were severe, and on some occasions the pain radiated to the cardiac region, and sometimes to the interscapular region. There was no jaundice, no chill, no fever, and no sweats. The patient weighed 250 pounds, was healthy in general appearance, and of good habits.

A physical examination showed a rapid pulse, 104 to the minute. Cogwheel inspiration was elicited at both apices anteriorly. The abdomen was 48 inches in circumference; there was tenderness on pressure in the right upper abdominal quadrant in the region of the pyloric end of the stomach; no tumor was found. The liver appeared not to be enlarged; the spleen was indistinctly palpable on deep inspiration; there was no ascites. A blood examination showed 5,540,000 erythrocytes, 9200 leukocytes, ratio 1 to 512, 75 per cent. hemoglobin (Fleischl), color index 0.67+. The differential count showed 59.8 per cent. polymorphonuclear neutrophiles, 25.2 per cent. lymphocytes, 5.6 per cent. large mononuclears, 4.2 per cent. transitionals, 5.2 per cent. eosinophiles. The erythrocytes were normal. No malarial parasites were

found. The urine was amber in color, acid in reaction, 1.028 in specific gravity, and there was a moderate cloudy sediment composed of pus. Neither albumin nor glucose was present. There was one stool daily, soft, mushy, and dark in color. An examination showed neither ova, embryos, adult parasites, nor protozoa. Occult blood was present by the aloin test, but not by the guaiac test; the aloin test was not very sharp. An Ewald test breakfast was removed in an hour, but on account of the retching, but few drops of gastric contents were obtained. This showed a good reaction for free hydrochloric acid by the Gunzburg method, but no other determinations were possible. The Cammidge reaction was positive. The patient was referred to Dr. Francis T. Stewart, for operation with a diagnosis of chronic pancreatitis. Dr. Stewart reviewed the work done, and after a second physical examination, said that he thought the patient had gallstones. He expressed doubt as to the efficiency of the Cammidge reaction in indicating disease of the pancreas. Under ether anesthesia, Dr. Stewart opened the abdomen in the region of the gall-bladder. The gall-bladder was distended with thick bile, and projected fully 2 inches below the costal margin. The pyloric end of the stomach, the duodenum, and the pancreas were examined and were found normal. No gallstones were found. The gall-bladder was drained. A pure culture of Micrococcus tetragenus was obtained from the bile. The drainage tube was accidentally expelled seven days after the operation. The line of the incision became infected, but finally healed entirely. Subsequently the patient had an attack of acute articular rheumatism, from which he recovered.

This patient's urine was examined seven times. The result before the operation has already been referred to. The Cammidge reaction was positive, X crystals being obtained. Fehling's test gave a trace of glucose. Just after the operation the Cammidge reaction was negative and Fehling's test was negative. After the drainage tube came out, and the wound started to close, four tests were made. The Cammidge reaction was positive in every one, two giving X crystals and two giving Y crystals. Fehling's test was negative in all four; the phenylhydrazine hydrochloride test was lost once, gave M crystals twice, and was negative once. The seventh examination was made about ten months after the operation. The Cammidge reaction was positive, Y crystals being found. Fehling's test and the phenylhydrazine hydrochloride test were both negative.

This case is No. 6 in our series and the details are not repeated in the history protocols.

After the experience with the two cases so far reported, we determined to make a study of numerous cases as they occurred in the Polyclinic Hospital and in our private practice, to determine the frequency of the occurrence of this reaction and its bearing upon

the diagnosis of pancreatic disease. While, as a rule, we selected patients for the purpose of this study who presented abdominal symptoms, we also performed the test in a number of cases in which the patients presented no such symptoms.

During the progress of the work we were furnished with a specimen of urine from one of the dogs in which pancreatitis had been

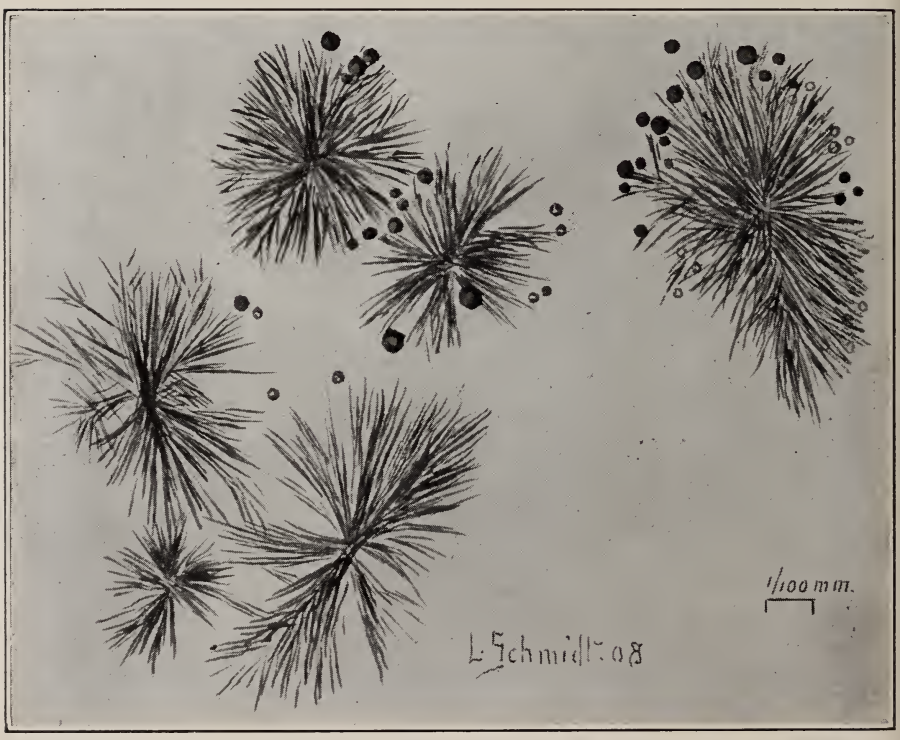


Fig. 1.—Crystals obtained from the urine of a dog in which pancreatitis had been induced experimentally.

experimentally produced by Dr. Joseph Sailer, in the Pepper Clinical Laboratory of the University of Pennsylvania. By comparing the crystals obtained from this urine (Fig. 1) with those obtained from the urine of some of our patients we discovered that we were obtaining crystals of two forms. One variety, which we call Y crystals in this report, was composed of delicate needles

with curved ends and a tendency to branch near the ends, arranged in loose rosettes, which corresponded in appearance with the crystals pictured by Cammidge (Fig. 2). The other variety, which we call X crystals, was composed of shorter and thicker needles, without curved ends, with no apparent tendency to branch, and arranged in more compact rosettes (Fig. 3).

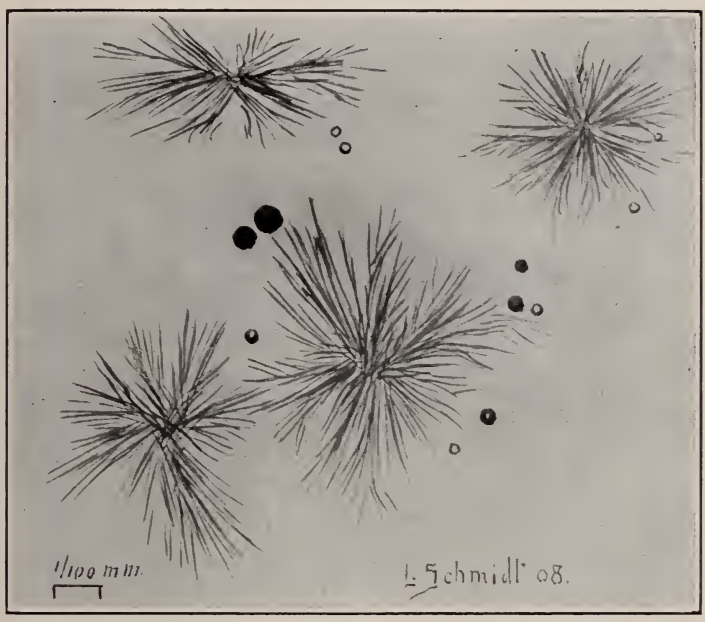


Fig. 2.—Y crystals obtained from Case V.

Specimens of the crystals were then referred to Dr. John Marshall, professor of chemistry in the school of medicine of the University of Pennsylvania, and to Dr. William H. Welker, demonstrator of physiological chemistry in the same institution. They expressed the opinion that the crystals were identical in composition and that some variation in the physical characters of the urine accounted for the variation in the appearance of the crystals obtained by our manipulations. Dr. Welker suggested that they were in all probability the result of the occurrence of maltose in small quantities in

the urine of the patients, and that the boiling with hydrochloric acid for ten minutes converted the maltose into a carbohydrate, which formed the crystalline osazone described by Cammidge. In order to test this theory, the urine of one of us, a portion of which had been previously tested and did not respond to the Cammidge reaction, was treated by Dr. Welker with maltose so that the amount of maltose in the specimen equalled 0.05 per cent. This specimen gave crystals closely resembling the Y crystals obtained with the Cammidge method (Fig. 4). No maltosazone crystals were found upon applying the phenylhydrazine hydrochoride test to the urine.

Fig. 3.— + Y crystals obtained from Case VII.

In a letter to the *Lancet*,[14] which seems to have been generally overlooked in the discussion of the nature of the Cammidge crystals, Cammidge said that his crystals "more nearly resembled phenylmaltosazone than phenylglucosazone crystals in most instances."

At this time a large amount of urine from one of the cases in our series (Case V) was treated as directed in the performance of Cammidge's C reaction and a considerable amount of the crystals was

obtained. Dr. Marshall determined that the melting point of these crystals was 184.5° C. Eichler[10] determined that the melting point of the Cammidge crystals was 182° C. Caro and Wörner[11] made their melting point between 150° and 160° C. Goodman[7] determined the melting point to be 155° C. In this connection it might be well to state that under certain conditions urea forms a crystalline compound with phenylhydrazine, and that the melting point of these crystals is 172° C.[20] This fact might explain the lower melting point obtained by some observers.

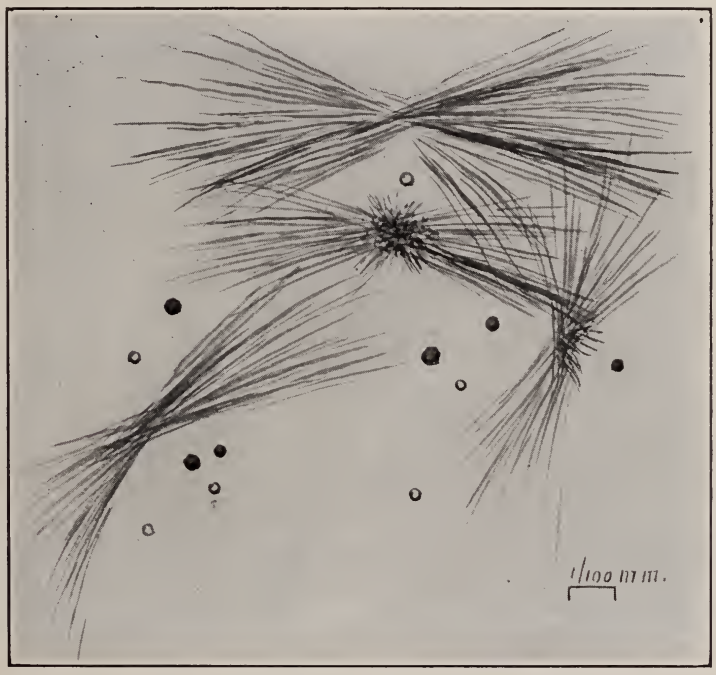


Fig. 4.—Crystals obtained from specimens of urine to which 0.05 per cent. solution of maltose had been added.

Table I.—Summary of Cases upon which the Cammidge Reaction was Studied

I. Cases in which a clinical diagnosis of pancreatitis was made:

Cammidge reaction.	Confirmed.
+ Y crystals (5)	Operation.
+ Y crystals (7)	No operation.
+ Y crystals (50)	Operation.

II. Cases of carcinoma of the pancreas:

+ X and Y crystals (13)	Operation.
+ X crystals (33)	Operation.

III. Cases in which the clinical diagnosis was not pancreatitis:

Cammidge reaction.	Diagnosis.
+ X crystals (1)	Varicose ulcer of the leg.
+ X crystals (2)	Intestinal obstruction.
+ X crystals (3)	Fracture of the right leg.
+ X crystals (4)	Dilatation of the stomach.
+ X and Y crystals (6)	Cholecystitis.
+ X and Y crystals (8)	Foreign body in the thigh.
+ X and Y crystals (9)	Osteoarthritis.
+ X and Y crystals (10)	Subacute gastritis.
+ X crystals (11)	Paratyphoid fever.
+ Y crystals (12)	Crushed leg.
+ Y crystals (14)	Hernia.
+ X and Y crystals (15)	Typhoid fever.
+ X and Y crystals (16)	Typhoid fever.
+ Y crystals (17)	Valvular heart disease.
+ X crystals (18)	Cholecystitis.
+ X crystals (19)	Fracture of the femur.
+ X crystals (20)	Influenza.
M crystals (21)	Myocarditis.
+ X crystals (22)	Typhoid fever.
+ Y crystals (23)	Inguinal sinus.
+ Y crystals (24)	Galactocele.
+ X and Y crystals (25)	Lobar pneumonia.
+ Y crystals (26)	Pott's fracture.
+ X crystals (27)	Septic peritonitis and empyema.
+ X crystals (28)	Hemoptysis.
+ Y crystals (29)	Fibroid uterus.
+ Y crystals (30)	Dermoid cyst of ovary.
+ Y crystals (31)	Laceration of the pelvic floor.
+ X crystals (32)	Pyosalpingitis.
+ Y crystals (34)	Gastritis and cholangitis.
+ X crystals (35)	Typhoid fever.
+ Y crystals (36)	Typhoid fever.
+ Y crystals (37)	Typhoid fever.
+ X crystals (38)	Acetanilid poisoning.
+ X crystals (39)	Septic arthritis.
+ Y crystals (40)	Inguinal hernia.
+ Y crystals (41)	Cirrhosis of the liver.
+ X and Y crystals (42)	Burns of the thigh.
+ Y crystals (43)	Carcinoma of the stomach.
+ Y crystals (44)	Miliary tuberculosis.
+ Y crystals (45)	Appendicitis.
+ Y crystals (46)	Typhoid fever.
+ X and Y crystals (47)	Cerebrospinal fever.
+ Y crystals (48)	Chronic gastritis.
+ Y crystals (49)	Cholecystitis.
+ Y crystals (51)	Acute cholecystitis.
+ X crystals (52)	Sarcoma of inguinal lymph nodes.
+ X crystals (53)	Appendicitis.

The urine from each patient was tested for albumin by the heat and nitric acid method, for glucose by the Fehling test and by the phenylhydrazine hydrochloride method, for Cammidge crystals by the C method described in Robson and Cammidge's book (2, pages 252 to 253). The reaction of the urine to litmus was also determined.

The phenylhydrazine hydrochloride test for glucose was done as follows: 0.25 gram of phenylhydrazine hydrochloride, and 0.5 gram of sodium acetate were added to one-half a test tube full of filtered urine and subjected to the action of boiling water in a water bath for one hour. At the end of that time the tube was stoppered and allowed to stand over night. The sediment was then examined microscopically, using a $\frac{1}{6}$-inch objective.

We examined the urine from 53 patients (see Table I). Of these, 3 were cases diagnosticated pancreatitis. These cases all gave a positive reaction; all showed Y crystals. The diagnosis in two of the cases was confirmed at operation (No. V and No. L); the other patient was not operated upon (No. VII). In Case V, eleven months after the operation, the Cammidge reaction was negative on two occasions. This in spite of the fact that a piece of the gland removed at operation showed a distinct interlobular and intralobular fibrosis (Fig. 6). Two cases were diagnosticated clinically carcinoma of the pancreas. Both gave a positive reaction; one (No. XIII) gave both X and Y crystals; the other (No. XXXIII) gave X crystals alone. In both cases the diagnosis was confirmed at operation; 47 cases were diagnosticated clinically as not being cases of pancreatitis; 8 of these were negative (Nos. IV, VIII, IX, X, XXXVII, XLIV, XLVI, and LIII); the patients were in the hospital for fracture of the leg, foreign body in the thigh, osteoarthritis, subacute gastritis, typhoid fever, miliary tuberculosis, typhoid fever, and appendicitis respectively.

One case, a case of myocarditis, gave the crystals which we call M crystals after the completion of the Cammidge test.

In 39 cases the reaction was positive; 18 of these gave Y crystals, 15 gave X crystals, and 6 gave both X and Y crystals.

The diagnosis of the cases giving the Y crystals are as follows: Crushed leg (No. XII), hernia (No. XIV and No. XL), valvular heart disease (No. XVII), inguinal sinus (No. XXIII), galactocele (No. XXIV), Pott's fracture (No. XXVI), fibroid uterus (No. XXIX), dermoid cyst of the ovary (No. XXX), laceration of the pelvic floor (No. XXXI), gastritis and cholangitis (No. XXXIV), typhoid fever (No. XXXVI), cirrhosis of the liver (No. XLI), carcinoma of the stomach (No. XLIII), appendicitis (No. XLV), chronic gastritis (No. XLVIII), and cholecystitis (No. XLIX and No. LI); 5 of these cases gave M crystals with the phenylhydrazine hydrochloride test, which makes the Cammidge test worthless in them.

The diagnoses of the cases giving the X crystals are as follows: Varicose ulcer of the leg (No. I), intestinal obstruction (No. II), fracture of the leg (No. III), paratyphoid fever (No. XI), cholecystitis (No. XVIII), fracture of the femur (No. XIX), influenza (No. XX), typhoid fever (No. XXII and No. XXXV), septic peritonitis and empyema (No. XXVII), hemoptysis (No. XXVIII), pyosalpingitis (No. XXXII), acetanilid poisoning (No. XXXVIII), septic arthritis (No. XXXIX), and sarcoma of the inguinal lymph nodes (No. LII). In 3 of these cases the phenylhydrazine hydrochloride test was not done; in 6, it gave M crystals, making the Cammidge test worthless.

The diagnoses of the cases giving both X and Y crystals were as follows: Cholecystitis (No. VI), typhoid fever (No. XV and No. XVI), lobar pneumonia (No. XXV), burns of the thighs (No. XLII), and cerebrospinal meningitis (No. XLVII). In these cases the M crystals were sometimes present and sometimes absent with the phenylhydrazine test.

The reaction was positive in 21 cases of abdominal disease; in 8 cases of disease of the upper abdomen; in 5 cases of disease of the lower abdomen, and in 8 cases of general abdominal disease. It was negative in 5 cases of abdominal disease; in 2 cases of disease of the upper abdomen; in 1 case of disease of the lower abdomen, and in 2 cases of general abdominal disease. In 8 cases of typhoid fever, included in the above classification as

cases of general abdominal disease, the reaction was positive in 6 and negative in 2. In 5 cases of gall-bladder disease the reaction was positive in all.

In 27 of the 60 tests in which the method was employed, we found crystals in the phenylhydrazine hydrochloride test tube like those illustrated in Fig. 5; we have called these M crystals.

Fig. 5.—M crystals obtained with phenylhydrazine test.

In 12 of these cases the Cammidge test gave X crystals; in 12 it gave Y crystals; in 1 it gave both X and Y crystals; in 1 it gave crystals of identical appearance with the crystals in the phenylhydrazine test tube, and in 1 the Cammidge reaction was negative. In all of these cases Fehling's test was negative.

These results indicate that some carbohydrate existed in the urine of the patients, but in too small a proportion to give a positive

reaction with Fehling's solution. The nature of this carbohydrate is a problem which we have not undertaken to solve. It is possible that we should exclude these cases from our list of cases giving

Fig. 6.—Interlobular and intralobular fibrosis of the pancreas (Case VI).

a positive Cammidge reaction. We have decided to retain these cases, however, as giving a positive reaction, because it is quite likely that many Cammidge tests are being done without the control of a phenylhydrazine hydrochloride test. It is absolutely

necessary, however, to insist upon both phenylhydrazine hydrochloride and Cammidge tests being done before forming an opinion as to the latter.

Reference to Table II will show that in some of the cases in which the crystals were present on one examination they were absent at other examinations, and, we believe, their presence

Fig. 7.—Necrosis of the pancreas (Case XXXIII).

merely indicates that the carbohydrate substance was present in those particular specimens in smaller proportion than in those in which the phenylhydrazine hydrochloride test alone failed to demonstrate it. The hydrolysis with hydrochloric acid, and the subsequent concentration of the solution by boiling, on the other hand, was sufficient to increase the quantity of proper car-

bohydrate and so produce the crystals on subsequent heating with phenylhydrazine hydrochloride.

In 3 of our cases we have been able to obtain a piece of the pancreas for histological examination either at operation or at autopsy. In Case V a well-marked interlobular and intralobular cirrhosis of the pancreas was present (Fig. 6). Eleven months after the operation the Cammidge reaction was done twice at intervals of two weeks. On both occasions the reaction was negative. It is impossible to think that the fibrosis shown in the photograph was no longer present and that the gland had returned to normal.

In Case XXXIII there were metastatic carcinomatous nodules in the pancreas at autopsy, and there was also acute necrosis of the gland (Fig. 7). In this case the reaction was positive on two occasions.

In Case XLIV the pancreas was normal. The Cammidge reaction was negative.

Conclusions. We have found the Cammidge reaction positive in 3 cases of pancreatic disease, in 2 cases of carcinoma of the pancreas, and in a great variety of diseases besides those of the pancreas, as diagnosticated by clinical methods alone.

We have included in our positive interpretation of results those cases in which our X crystals were found; those cases in which our Y crystals were found; and those cases in which both X and Y crystals were found.

We have found that a large number of those patients was suffering from disease of the abdominal organs; 21 cases out of 47; such as cholecystitis, carcinoma of the stomach, and typhoid fever. It is easy to understand how these pathological conditions could so affect the function of the pancreas as to result in the excretion of the substance in the urine which produces the crystals described when the urine is boiled with hydrochloric acid.

In many other cases in which a positive reaction was found, such as varicose ulcer of the leg, fracture of the leg, burns of the thighs, sarcoma of the inguinal lymph nodes, and valvular heart disease, arteriosclerotic processes were progressing in the patients, and enough disturbance of the circulation in the pancreas might

easily have resulted so that the substance which gives the reaction would have been formed and excreted. Watson[4] referred to the possibility of arteriosclerotic processes and catarrhal conditions of the intestinal tract so affecting the pancreas as to produce the reaction.

We think it a mistake to interpret every positive Cammidge reaction as indicative of organic disease of the pancreas. We believe that the positive reaction indicates a disturbed pancreatic function, and that the substance in the urine which produces the crystals results either from disorder of the pancreatic secretion, or from the elimination of small quantities of maltose or other disaccharid.

The Cammidge reaction is often done for the purpose of determining the advisability of an operation. From this point of view the reaction is not to be depended upon.

It should never be used as a guide to the performance of an operation unless the test with phenylhydrazine hydrochloride has been done and has failed to produce M crystals. If this reaction gives no crystals and the Cammidge reaction is still positive and the patient complains of upper abdominal symptoms, particularly pain, the reaction may be looked upon as a link in the chain of evidence pointing either to pancreatic disease, disease of the gall-bladder, or disease of some neighboring organ. In the absence of such symptoms the presence of the reaction even with absence of M crystals in the phenylhydrazine hydrochloride tube should be looked upon merely as an interesting discovery.

PROTOCOLS OF CLINICAL RECORDS

Case I.—Female, colored, aged fifty-nine years, washerwoman, admitted to the service of Dr. F. T. Stewart (16,247) with a diagnosis of varicose ulcer of leg.

Family history, negative.

Previous history: Smallpox at three years; malarial fever; two miscarriages, was operated upon in 1906 for tumor of thigh, and in 1905 had a gastroenterostomy for "stomach trouble."

Present condition: Varicose veins of one year's duration in right leg; ulcer of short duration.

During her stay in the hospital she had several attacks of vomiting. An examination of the gastric contents after a test meal showed: Total quantity removed, 175 c.c.; total acidity, 55; free hydrochloric acid, 17; lactic acid, trace; epithelium, starch granules, and some large motile bacteria. A second exploratory operation was advised on acount of the vomiting, but was refused.

The Cammidge reaction was positive on October 28, 1908, X crystals being found, and a microscopic examination of the feces showed nothing abnormal on the same date. A second examination showed a positive Cammidge reaction, X crystals being found. Fehling's test was negative.

Case II.—Female, colored, aged fifty-seven years, cook, admitted to the service of Dr. A. A. Eshner (16,221) with a diagnosis of intestinal obstruction.

Family history, negative.

Previous history: Pneumonia in 1906. Celiotomy at some time in the past.

Present condition: The patient complained of bearing-down pains in the epigastrium, of four days' duration. The pain radiated to both sides of the upper abdomen, was intense, and lasted twenty-four hours. After this attack the pain was constantly present, but was not so severe; it was worse at night than in the day time. The patient said she had high fever during and after the attack; she spat blood for a week before her admission, and maintained that her stools had contained blood. Three days after her admission she had a chill. The physical examination showed badly decayed teeth; a furrowed, heavily coated tongue, with a slight tremor; slightly icteroid conjunctivæ; palpable axillary and cervical lymph nodes, and enlarged inguinal lymph nodes; lungs negative; heart muffled; systolic sound and suspicious sound at apex, suggesting a systolic murmur; liver dulness from the seventh interspace to the costal margin; spleen not palpable; epigastric tenderness. During her stay in the hospital the patient continued to expectorate blood-tinged mucus; an examination of this failed to show tubercle bacilli. Her temperature showed a daily afternoon rise, between noon and four o'clock, and she lost weight. The agglutination test with bacillus typhosus was negative on two occasions. A blood count showed 3,410,000 erythrocytes and 19,500 leukocytes. The differential count showed 86.4 per cent. polymorphonuclear neutrophiles, 5.4 per cent. lymphocytes, and 8.2 per cent. large mononuclears.

Thirteen days after her admission she was operated upon. A broad band of omentum adherent to the abdominal wall at the site of the former operation, which caused a partial obstruction of the colon and a portion of the small intestine was cut. The liver, gall-bladder, and kidneys were normal. No tumors were found. No note was made concerning the condition of the pancreas. The patient died eleven days after the operation. No autopsy was obtained. The urine contained albumin and hyaline and granular casts.

The Cammidge reaction was positive on October 28, 1908. The feces contained nothing abnormal.

Case III.—Male, white, aged fifty-four years, rag dealer, admitted to the service of Dr. L. W. Steinbach (16,175) with a diagnosis of fracture of both bones of right leg.

Family history, negative.

Previous history, negative.

Present condition: The patient fell through a hole in a hay loft and broke both bones of his right leg, just above the ankle. During his stay in the hospital the fracture had to be refractured on account of deformity. The patient's urine contained no albumin, but a few hyaline casts were present. His pulse varied from 60 to 92 a minute.

The Cammidge reaction was positive on three occasions, X crystals being obtained. On one occasion Cammidge's A, B, and C reactions were done on this urine and all gave the same result.

Case IV.—Male, white, aged forty-seven years, brass moulder, was a private patient who had pernicious anemia.

Family history, negative.

Previous history, negative.

Present condition: The patient had been complaining of indigestion, loss of weight, chills, and anemia for three years. Examination of abdomen showed epigastrium distended, splashing, greater curvature was near the umbilicus. The examination of the gastric contents forty-five minutes after an Ewald test breakfast showed: Total quantity removed, 60 c.c.; total acidity, 60; no free hydrochloric acid.

A blood examination showed: 3,200,000 erythrocytes, 7300 leukocytes, a ratio of 1 leukocyte to 438 erythrocytes, 82 per cent. hemoglobin, color index, 1.28.

The differential count showed:

	Per cent.
Polymorphonuclear neutrophiles	47.3
Lymphocytes	43.4
Large mononuclears	4.6
Transitionals	2.9
Eosinophiles	1.8
	100.0

No nucleated red cells were seen.

The urine was examined once. The Cammidge reaction was negative. The phenylhydrazine hydrochloride test and the Fehling test were both negative.

Case V.—Female, white, aged forty-nine years, housewife, admitted to the service of Dr. F. T. Stewart (16,377) with a diagnosis of gallstones.

Family history, negative.

Previous history: Usual diseases of childhood. Typhoid fever at the

age of eighteen; amygdalitis and bronchitis in childhood; no genito-urinary disease; menopause at age of forty-eight.

Present condition: About four years ago the patient had an attack of severe pain in the right hypochondriac region, in the region of the ninth costal cartilage. The pain was very severe, was referred around the body, especially to the right side of the chest and to the right shoulder. There was also some pain in the left chest. After treatment pain and soreness subsided and she was free from pain for eight months. Then she had another attack. She had a third attack two years later. During the past eight months the patient has had a number of similar attacks. The pain appears to be made worse by eating, there is a great deal of eructation of gas and fulness in the stomach, and the bowels are usually constipated. On admission, examination revealed tenderness on deep pressure over the region of the gall-bladder. An Ewald test breakfast was withdrawn in one hour: Total quantity, 30 c.c.; free hydrochloric acid, absent; total acidity, 24; lactic acid, present; acetic acid, present; no Oppler-Boas bacilli found. A blood examination showed 5,300,000 erythrocytes, 7700 leukocytes, and 93 per cent. hemoglobin. Seven days after admission the patient was operated upon under ether anesthesia. The gall-bladder was large and flabby, but no stones could be felt through its walls. The stomach and liver were apparently normal. The pancreas was very firm and was uniformly enlarged. No nodules were found in the organ and the neighboring lymph nodes were not enlarged. The contents of the gall-bladder were aspirated; they were light in color and contained much mucus. No stones were found. The gall-bladder was drained externally. The tube was accidentally expelled nine days after the operation; the wound closed promptly, and the patient was discharged ten days later.

A piece of the pancreas was removed at the operation and examined histologically by Dr. James A. Kelly: "Microscopic examination shows marked overgrowth of fibrous connective tissue, mainly within the lobules, although there is a marked increase between the lobules. The pancreatic cells are compressed in places. Diagnosis: Chronic interacinar pancreatitis." (Fig. 6.)

Dr. Kelly also obtained a pure culture of Bacillus coli communis from the aspirated bile.

The Cammidge reaction was positive on three occasions, before, just after, and four days after the operation. Y crystals were obtained. Fehling's test for glucose was negative on all three occasions. Eleven months after the operation the urine was again examined and the Cammidge reaction was found to be negative. Both Fehling's test and the phenylhydrazine hydrochloride test were negative. Two weeks later the same results were obtained, except that the phenylhydrazine hydrochloride test could not be done because the quantity of urine sent was too small.

Case VI.—See detailed description, page 64.

Case VII.—Male, white, aged thirty-five years, steamship agent, was a private patient (711) in whom a diagnosis of chronic pancreatitis was made.

Family history, negative.

Previous history: The patient had had the usual diseases of childhood, except scarlet fever. He had pneumonia at the age of five years. He went to Yucatan, Mexico, at the age of twenty-nine years, in 1902. In 1900, he had malaria; in 1903, he had a mild attack of yellow fever. He had an Oxyuris vermicularis infection six months before he was first seen. His habits were good.

Present condition: The patient complained of diarrhea. He always had three stools a day, sometimes more than three. The stools were watery, dark brown in color, and contained mucus; on two occasions they contained blood. He had not had dysentery. He had belching, distention after eating, and the passage of considerable flatus. A physicial examination showed a well-nourished man, weight 150 pounds, sallow complexion, a deficient muscular quality to the systolic sound of the heart, slight tenderness on pressure in the lower quadrants of the abdomen. The liver dulness extended from the fifth rib to the costal margin; its edge was indistinctly palpable on deep pressure. The upper border of splenic dulness was at the eighth rib; its edge was not palpable. A blood examination showed 5,820,000 erythrocytes, 11,520 leukocytes, ratio 1 to 509; 97 per cent. hemoglobin (Sahli), color index 0.83+. The differential count showed 55.4 per cent. polymorphonuclear neutrophiles, 36.6 per cent. lymphocytes, 2.0 per cent. large mononuclears, 0.2 per cent. transitionals, 5.8 per cent. eosinophiles. The erythrocytes were normal. No parasites were found. An examination of the feces showed a large, brown, frothy stool with large quantities of mucus. No ova, no embryos, no adult parasites, and no protozoa found.

The urine was pale amber in color, neutral in reaction; it had a specific gravity of 1.011, and a slight amount of white granular sediment which contained calcium and magnesium phosphate crystals, bladder epithelium, and a few bacteria. It contained neither albumin nor glucose. Phosphates were present. The Cammidge A reaction was positive; the B reaction was negative.

The patient was advised to have a drainage of his gall-bladder done for chronic pancreatitis; but could not spare the time from his post in Mexico. Four months later when on a short business trip to the United States his urine was examined again. The Cammidge reaction was negative. Fehling's test was negative. The phenylhydrazine hydrochloride test was not done.

Five months later he was complaining of the same symptoms. The examinations were repeated and showed practically the same conditions as demonstrated at the first examination. The Cammidge reaction was positive, Y crystals being found. The phenylhydrazine hydrochloride test gave a few broken crystals. Fehling's test was negative.

The advice to have the gall-bladder drained was repeated, but was again rejected.

Case VIII.—Male, white, aged twenty-nine years, waiter, admitted to the service of Dr. Morris Booth Miller (16,419) with a diagnosis of needle in the thigh.

Family history, negative.

Previous history, negative.

Present condition: Ten days before admission the patient sat down on a chair in which there was a needle, which ran into his right thigh. Under ether the needle was sought for but not found. Eight days later the patient was operated upon again under ether anesthesia, after localization by the *x*-rays; but the needle was not found. Eighteen days later the needle had worked near the surface and was easily extracted. The patient's urine the day after the second operation did not show the Cammidge reaction. The phenylhydrazine test showed M crystals. Fehling's test was negative.

Case IX.—Male, white, aged ten years, schoolboy, admitted to the service of Dr. James K. Young (16,215) for osteoarthritis.

Family history, negative.

Previous history, negative.

Present condition: Fourteen months before admission the patient was suddenly seized with intense pains in his arms, legs, and neck. He had fever and was confined to bed for nine months. The joints became swollen and remained so from the time of that attack. A radiological study by Dr. Walter Estell Lee showed a cystic degeneration of the bones and joints of the hands and wrists.

From the time of his admission his temperature had a general upward tendency. The day before the *x*-ray picture was made the morning temperature was 102° F. After the *x*-ray examination the temperature was almost always normal or below; occasionally the thermometer registered above 99° F. without apparent cause; the highest point being 99.8° F. Blood examinations, which were made on three occasions, showed a slight degree of chloroanemia and a moderate leukocytosis. The urine contained 0.3 per cent. albumin by the Esbach method and hyaline casts. The Cammidge reaction was negative on December 2. Fehling's test was negative. The phenylhydrazine test was lost.

Case X.—Male, white, aged thirty-four years, drug clerk, was a private patient (717) who had subacute gastritis.

Family history, negative.

Previous history: The patient had the usual diseases of childhood, except scarlet fever. In 1896, he had typhoid fever; in 1898, he had pneumonia. His habits were good.

Present condition: He complained of pain in the epigastrium of five

weeks' duration. The pain began when his stomach was empty and was relieved by eating. The pain did not radiate; it did not keep him awake at night; and it was unattended by nausea or vomiting. Physical examination showed a rapid heart action, pulse 100; a moderately distended abdomen with a sense of increased resistance in the epigastrium, above and to the right of the umbilicus, which was tender on pressure. An Ewald test breakfast was withdrawn in one hour and showed a total quantity of 172 c.c.; free hydrochloric acid, 30; total acidity, 58; lactic acid, negative; occult blood, negative. The urine was pale amber in color, acid in reaction, and had a specific gravity of 1.023. There was a slight cloudy sediment composed of pus. Neither albumin nor glucose was present. An examination of the feces showed occult blood by both aloin and guaiac tests; but a subsequent examination when the patient was on a strict milk diet showed no occult blood. Under simple dietetic treatment the symptoms entirely disappeared.

The patient's urine was examined once. The Cammidge reaction was negative. The phenylhydrazine hydrochloride and Fehling's tests were negative.

Case XI.—Male, white, aged thirty-four years, cigar maker, was admitted to the service of Dr. A. A. Eshner (16,490) with a diagnosis of paratyphoid fever.

Family history, negative.

Previous history: Did not remember to have had the usual diseases of childhood. Had an attack of influenza in 1907.

Present condition: The patient was admitted with a temperature of 102.4° F. He had been ill for three days complaining of headache, chilliness, and fever. The symptoms followed eating oysters. The patient was in the hospital for sixteen days, during which time he had a continued fever, with a maximum of 104° F. two days after admission, with a subsequent generally downward course. A blood examination showed 4,800,000 erythrocytes, 9600 leukocytes, and 92 per cent. hemoglobin. Physical examination showed some enlargement of the inguinal glands, a slight irregularity of the cardiac rhythm, a palpable spleen, which extended one finger's breadth below the costal margin, and a few red macules, which resembled the eruption of typhoid fever.

The examination of the urine three days after admission showed Cammidge reaction positive, X crystals being obtained, and M crystals with the phenylhydrazine test. The urine was negative to Fehling's test for glucose. One week later the same result was obtained.

Case XII.—Male, white, aged seventy-eight years, laborer, admitted to the service of Dr. Morris Booth Miller (16,499) with a diagnosis of crushed legs and shock.

Family history, negative.

Previous history, negative.

Present condition: While working in a foundry sustained a compound comminuted fracture of the right leg and severe contusions of the left leg. On the same day, under ether anesthesia, the right leg was amputated. The stump became infected and an abscess was opened in it. A physical examination was negative except for a few sibilant rales in both lungs anteriorly. The patient died after a chill. No autopsy was obtained.

One week after admission the urine gave a positive Cammidge reaction, Y crystals being found. The phenylhydrazine test showed M crystals present. The test with Fehling's solution showed no glucose.

Case XIII.—Male, white, aged forty-five years, mill worker, admitted to the service of Dr. C. B. Farr (16,529) with a diagnosis of carcinoma of the pancreas.

Family history, negative.

Previous history, negative.

Present condition: The patient was admitted complaining of pain in the epigastrum which was not affected by food nor by pressure. The symptoms were of two months' duration and had been increasing in severity just before admission. He had lost more than twenty pounds in weight. He had been treated at the Medico-Chirurgical Hospital for carcinoma of the pancreas. There was no fulness or distress in the stomach, the pain was relieved by taking food, there was some pyrosis and belching, and some nausea. He had vomited once; the vomitus contained no blood. His bowels were constipated. After a test meal the gastric contents showed free hydrochloric acid, 38; total acidity, 65; there was a moderate amount of mucus present. The patient had had difficulty in swallowing solid food, but he took the tube readily. A physical examination showed a markedly emaciated man, with generalized dark bluish pigmentation of the skin, which he had always had, and a similar pigmentation of the mucous membranes. He was cyanotic; but there was no jaundice, and no edema. There was marked varicosity of the veins of both legs. No marked increase in the size of the superficial lymph nodes. The arteries were atheromatous and sclerotic. The lungs were slightly emphysematous. The heart was slightly enlarged to the right. Liver dulness extended from the sixth interspace to a little below the costal margin; its edge was distinctly palpable. The splenic dulness extended from the eighth rib to one inch below the costal margin; its edge was palpable. The abdomen showed a slight bulging in the right inguinal region, and a left-sided femoral hernia. There was a definite mass in the right side of the epigastrium, three fingers' breadth below the tip of the ensiform cartilage, which was somewhat elongated laterally, and which pulsated slightly, and moved down with inspiration. The gastric tympany extended to the right of the parasternal line and one finger's breadth below the umbilicus. A blood count showed 3,480,000 erythrocytes, 13,600 leukocytes, and 60 per cent. hemoglobin (Dare). The differential count showed 64.2 per cent. polymorphonuclear neutrophiles,

14.8 per cent. lymphocytes, 9.8 per cent. large mononuclears, 0.6 per cent. transitionals, 10.2 per cent. eosinophiles, and 0.4 per cent. basophiles.

After a second test meal the gastric contents showed no free hydrochloric acid, total acidity, 40; large amount of mucus. A second blood examination showed 4,570,000 erythrocytes, 12,800 leukocytes, 61 per cent. hemoglobin. The differential count showed 47.5 per cent. polymorphonuclear neutrophiles, 34.5 per cent. lymphocytes, 4.5 per cent. large mononuclears, 3 per cent. transitionals, 10.5 per cent. eosinophiles. The feces showed no occult blood either by the aloin or the guaiac tests. A few trichocephalus trichiuris ova were found on microscopic examination. About four weeks after admission, under ether anesthesia, an exploratory celiotomy was done by Dr. Morris Booth Miller. The stomach was normal, but was displaced downward by the pancreas. The pancreas was hard and nodular and pulsating throughout its entire course. The diagnosis of carcinoma of the pancreas was confirmed.

The patient went progressively down after this and died about one month later. A few days before death a mass developed in the left side of his neck which filled the entire supraclavicular fossa. It was about four inches long; extended an inch and one-half above the clavicle; was tender on pressure, hard on palpation; and the skin over it was edematous. There was some swelling in the supraspinous fossa of the same side. On the same day that this growth was found 1700 c.c. of fluid were removed from the left pleural cavity. The sediment in this fluid was composed principally of endothelial cells and a few lymphocytes. The endothelial cells were not well preserved; many of them, however, had double nuclei. No differential count could be made on account of the great number of bacteria in the specimen. There was no autopsy.

The urine showed a positive Cammidge reaction, Y crystals being found. The phenylhydrazine hydrochloride test showed M crystals. Fehling's test showed no glucose fifteen days before the operation.

A specimen of urine sent to Dr. Goodman at the Pepper Laboratory gave a negative Cammidge test eleven days before the operation. Salomon's test for carcinoma of the stomach was also negative. An oil test meal examined by Dr. Farr after Volhard's method showed absence of trypsin.

Two other examinations were made by us in this case, one before and the other after the operation. Both were positive; the former gave us typical Y crystals and the latter X crystals. Neither was positive to Fehling's test. The former test with phenylhydrazine was lost; the latter gave us M crystals.

Case XIV.—Male, white, aged twenty years, telegraph operator, admitted to the service of Dr. Morris Booth Miller (16,519) with a diagnosis of inguinal hernia.

Family history, negative.

Previous history: Had the usual diseases of childhood; had an attack of rheumatic fever in 1906.

Present condition: Three years ago the patient noticed a small lump on the left side, just above the scrotum. The tumor was found to be an inguinal hernia. It had not increased in size since it made its first appearance. Under ether anesthesia the operation for radical cure was done. There was a slight febrile reaction after the operation, the temperature on one occasion reaching 100.8° F. The wound was not infected.

The urine showed a positive Cammidge reaction on two occasions, both after the operation. In both Y crystals were found. In both the phenylhydrazine hydrochloride test gave M crystals; in neither was Fehling's test positive.

Case XV.—Male, white, aged thirty-three years, carpenter, admitted to the service of Dr. A. A. Eshner (16,518) with a diagnosis of typhoid fever.

Family history, negative.

Previous history: The patient had the usual diseases of childhood. He said he had had typhoid fever in 1888 and again in 1892.

Present condition: The patient was admitted with a temperature of 100.6° F., which by midnight had reached 104.2° F. Subsequently the patient had a continued fever of seven days' duration, which progressively fell to normal. He had been ill one week on admission, complaining of headache, abdominal discomfort, slight epistaxis, anorexia, and weakness. There was no chill. The patient had diarrhea. The physical examination showed nothing abnormal except a few moist rales at both bases posteriorly.

The urine showed a positive Cammidge reaction on two examinations; Y crystals were obtained in one, X crystals in the other. The phenylhydrazine hydrochloride test showed M crystals; Fehling's test was negative for glucose in both specimens.

Case XVI.—Male, white, aged twenty-seven years, laborer, was admitted to the service of Dr. A. A. Eshner (16,583) with a diagnosis of typhoid fever.

Family history, negative.

Previous history: Did not remember to have had the usual diseases of childhood. Said that he had typhoid fever six months ago on landing in the United States from Russia.

Present condition: The patient was admitted with a temperature of 100.8° F., which had risen to 104.2° F. in four hours. He ran a course of continued fever for nine days, the maximum temperature being 105.2° F., the minimum 101.2° F. The physical examination showed feeble cardiac systolic sound, accentuated diastolic sound, enlarged spleen, abdomen distended and tympanitic, many rose spots over chest and abdomen. Nine days after admission the patient died in a highly toxic condition.

The patient's urine was examined twice. In both instances the Cammidge

reaction was positive. At the first examination X crystals were obtained, which, however, were not typical; at the second examination Y crystals were obtained. Fehling's test was negative in both examinations. The phenylhydrazine hydrochloride test was lost at the first examination; at the second examination M crystals were found.

Case XVII.—Female, white, aged fifty years, no occupation, was admitted to the service of Dr. A. A. Eshner (16,579) with a diagnosis of valvular heart disease and dropsy.

Family history, negative.

Previous history: The patient had had measles during childhood. She had an attack of rheumatism sixteen or seventeen years ago, and another attack in 1908. Menopause, one year ago. She had seven children and one miscarriage.

Present condition: The patient had been sick for about four years with abdominal pain, pain in the back and in the left side, which kept her awake at night. The pain was usually worse in the umbilical region. She complained of dyspnea, general edema, and headache.

The patient was in the ward ten days and was then discharged.

Her urine was examined twice. In both instances the Cammidge reaction was positive, Y crystals being found. Neither specimen gave a positive reaction with Fehling's solution. At the first examination the phenylhydrazine hydrochloride test was lost; at the second examination M crystals were found.

Case XVIII.—Female, white, aged forty-five years, without occupation, was admitted to the service of Dr. A. A. Eshner (16,578) with a diagnosis of cholecystitis.

Family history, negative.

Previous history: The patient had had measles when a child, and typhoid fever at the age of sixteen. She had one miscarriage, which was followed by phlebitis. Menopause at the age of thirty-six.

Present condition: Two weeks before admission the patient began to complain of a pain in her right side, which extended to the midline of the abdomen and to the back, and which sometimes radiated to her heart. The pain had progressively increased in severity. There was a period of absolute constipation for over a week. The pain appeared to have been in the region of the gall-bladder and was frequently referred to the left shoulder; no pain in the right shoulder. There was a constant pain low down in the back. She vomited whenever she took any food. Five days before admission she had a severe attack of pain at night. On the day of admission she had another severe attack at noon, which was also referred to the left shoulder. Stools colorless. The temperature on admission was 98° F., but the next morning the thermometer registered 99.4° F. A blood examination showed 4,600,000

erythrocytes, 8200 leukocytes, 50 per cent. hemoglobin. The differential count showed 82 per cent. polymorphonuclear neutrophiles, 13 per cent. lymphocytes, 2 per cent. large monoculears, 2 per cent. transitionals, 1 per cent. eosinophiles. She was discharged without operation. The urine was examined twice. On both occasions the Cammidge reaction was positive, X crystals being found. The phenylhydrazine hydrochloride test gave M crystals on both examinations; Fehling's test was negative at both examinations.

Case XIX.—Male, colored, aged eighteen years, teamster, was admitted to the service of Dr. Morris Booth Miller (16,372) with a diagnosis of fracture of the lower third of the femur.

Family history, negative.

Previous history, negative.

Present condition: The patient was admitted for a fracture of the left femur at the junction of the middle and lower thirds. The fracture united without complications.

The patient's urine was examined once. The Cammidge reaction was positive, X crystals being found. The phenylhydrazine hydrochloride test gave M crystals; Fehling's test was negative.

Case XX.—Male, white, aged twelve years, schoolboy, was admitted to the service of Dr. A. A. Eshner (16,633) with a diagnosis of influenza.

Family history: Father died in 1908, of pulmonary tuberculosis.

Previous history: The patient had measles. In 1908, had a cough during the winter, which disappeared during the summer.

Present condition: The patient was admitted with a temperature of 102.4° F. He had been ill for two or three weeks, complaining of a dry cough, left-sided headache, pain in the left side of the thorax, worse on deep inspiration, loss of weight, constipation, anorexia, nausea, and one attack of vomiting. The temperature fell rapidly to normal.

His urine was examined once and the Cammidge reaction was positive, X crystals being found. The phenylhydrazine hydrochloride test gave M crystals. The reaction to Fehling's solution was negative.

Case XXI.—Male, colored, aged fifty-five years, steward, was admitted to the service of Dr. A. A. Eshner (16,634) with a diagnosis of myocarditis.

Family history: Father died of cardiac and renal disease at the age of fifty-two years.

Previous history: Patient had the usual diseases of childhood. He had smallpox. Smoked to excess, had always been a hearty eater.

Present condition: The patient had noticed dyspnea on exertion for two years. He had lost weight for one month. Was refused life insurance ten years ago on account of albuminuria. He was admitted to the hospital on account of dyspnea on exertion, and puffiness beneath the eyes. The physical

examination showed an enlargement of the heart to the right, to the left, and downward. Sounds feeble, no murmurs. The urine contained albumin and hyaline casts.

The urine was examined once. The Cammidge reaction was negative. The tube contained typical M crystals. The phenylhydrazine hydrochloride test showed M crystals. Fehling's test was negative.

Case XXII.—Male, colored, aged twenty-two years, laborer, was admitted to the service of Dr. A. A. Eshner (16,599) with a diagnosis of typhoid fever.

Family history, negative.

Previous history, negative.

Present condition: The patient was admitted with a temperature of 102.6° F. He had been ill for two or three days with fever, slight headache, and muscular pains in the back. He had had several attacks of nose-bleed; his appetite was poor, and his bowels were constipated. The leukocyte count gave 8400, in the cubic millimeter. The agglutination test with bacillus typhosus was negative. A diazo reaction was positive. He was in the ward thirty-three days and showed a continued fever of the typhoid type with prompt convalescence, which began on the twelfth day after admission.

His urine was examined once. The Cammidge reaction was positive, X crystals being found. The phenylhydrazine hydrochloride test gave M crystals; Fehling's reaction was negative.

Case XXIII.—Male, white, aged forty-six years, barber, was admitted to the service of Dr. Morris Booth Miller (16,678) with a diagnosis of inguinal sinus.

Family history, negative.

Previous history: The patient had been a heavy drinker and smoked a good deal.

Present condition: The patient had been operated upon by Dr. Miller in November, 1908, for double inguinal hernia at the Philadelphia General Hospital. The wound on the right side became infected and had been discharging pus. Under ether anesthesia the sinus was opened, curetted, and dressed antiseptically.

His urine was examined once. The Cammidge reaction was positive, Y crystals being found. The test with phenylhydrazine hydrochloride gave M crystals. Fehling's test was negative.

Case XXIV.—Female, white, aged eighteen years, seamstress, was admitted to the service of Dr. F. T. Stewart (16,745) with a diagnosis of pectoral abscess.

Family history, negative.

Previous history, negative.

Present condition: Patient had had a lump in the right breast for two years. This lump increased in size progressively until it was as large as the yolk of an egg. Under ether anesthesia the cyst was dissected out. The

microscopic examination showed it to be a galactocele. The patient's urine was examined once. The Cammidge reaction was positive, Y crystals being obtained. The phenylhydrazine hydrochloride test and Fehling's test were both negative.

Case XXV.—Female, white, aged twelve years, schoolgirl, was admitted to the service of Dr. David Riesman (16,753) with a diagnosis of lobar pneumonia.

Family history, negative.

Previous history, negative.

Present condition: Patient was admitted with a temperature of 101° F., which rose to 102.6° F. in an hour. She had a typical attack of pneumonia of the right lower lobe.

The urine was examined once. The Cammidge reaction was positive, both X and Y crystals being found. The phenylhydrazine hydrochloride test gave M crystals; Fehling's test was negative.

Case XXVI.—Female, colored, aged forty years, chambermaid, was admitted to the service of Dr. John B. Roberts (16,762) with a diagnosis of Pott's fracture.

Family history, negative.

Previous history: The patient had had scarlet fever, diphtheria, and mumps in childhood. Typhoid fever at the age of seventeen. She had had two children, but no miscarriages.

Present condition: As a result of a fall on the ice the patient sustained a Pott's fracture of the right fibula.

The urine was examined once. The Cammidge reaction was positive, Y crystals being found. Both the phenylhydrazine hydrochloride and Fehling's test were negative.

Case XXVII.—Female, colored, aged twenty-four years, housewife, was admitted to the service of Dr. William R. Nicholson (16,799) with a diagnosis of vaginal discharge.

Family history, negative.

Previous history: The patient had had measles and typhoid fever when small.

Present condition: The patient, after missing a menstrual period, began to bleed. It was afterward learned that she had an abortion performed, or that she did an abortion on herself. Under ether anesthesia a dilatation and curettement were done. Later, empyema developed; the patient had a septic temperature, and died of toxemia. At autopsy the uterus was found ruptured anteriorly between the peritoneum and the floor of the pelvis. An abscess had formed. The pus burrowed along the attachment of the broad ligament and along the attachment of the descending mesocolon, through the diaphragm, producing an acute septic general peritonitis and left-sided empyema. A portion of the pancreas saved for histological examination was lost.

The urine of this patient was examined once. The Cammidge reaction was positive, X crystals being found. The phenylhydrazine hydrochloride test and Fehling's test were both negative.

Case XXVIII.—Female, colored, aged thirty-six years, housewife, was admitted to the service of Dr. David Riesman (16,825) with a diagnosis of hemoptysis.

Family history: One brother died of pneumonia, and one sister died of bronchopneumonia.

Previous history: Patient had chickenpox and whooping-cough during childhood; had a severe attack of bronchitis ten years ago; had five children and one miscarriage.

Present condition: The patient had had a cold and cough all winter, beginning in November, 1908. The cough was productive, and there was chest pain. Two days before she was admitted she began to expectorate blood, and finally she had quite a marked hemorrhage. Loss of weight not marked; night sweats not marked. Sputum did not contain tubercle bacilli. No definite signs of tuberculosis found on physical examination.

The patient's urine was examined once. The Cammidge reaction was positive, X crystals being found. Neither the phenylhydrazine hydrochloride test nor the Fehling's test was positive.

Case XXIX.—Female, white, aged forty-one years, housewife, was admitted to the service of Dr. William R. Nicholson (16,827) with a diagnosis of fibroid uterus, cystocele, rectocele, and cystitis.

Family history, negative.

Previous history: The patient had had measles and typhoid fever in childhood. At the age of fifteen years had malarial fever; and an attack of pneumonia about ten years ago. The patient had one child and one miscarriage. She had had a plastic pelvic operation seven years ago.

Present condition: The patient had been constipated for about eight months with backache and frequent micturition. She had noticed a mass in her right side. Two days after admission she was operated upon under ether anesthesia. The fibroid uterus was removed by celiotomy. About four weeks later, under ether anesthesia, the cystocele and rectocele were repaired. After the operations there was a moderate febrile reaction.

The patient's urine was examined once. The Cammidge reaction was positive, Y crystals being found. Both the phenylhydrazine hydrochloride and Fehling's tests were negative.

Case XXX.—Female, colored, aged twenty-three years, housewife, was admitted to the service of Dr. William R. Nicholson (16,777) with a diagnosis of ovarian cyst.

Family history, negative.

Previous history: The patient had had measles during her childhood; she had had no children and no miscarriages.

Present condition: The patient was admitted for a tumor in the right side of the abdomen and leucorrhea. Under ether anesthesia a right ovarian dermoid cyst was removed by celiotomy. Recovery was uneventful.

The patient's urine was examined once. The Cammidge reaction was positive, Y crystals being found. Both the phenylhydrazine hydrochloride and Fehling's tests were negative.

Case XXXI.—Female, white, aged twenty-six years, housewife, was admitted to the service of Dr. J. M. Baldy (16,729) with a diagnosis of laceration of the cervix and perineum.

Family history, negative.

Previous history: The patient had had measles in childhood; she had had one child and one stillborn infant.

Present Condition: The patient was lacerated in the delivery of the stillborn child. Under ether anesthesia the lacerations were repaired. The recovery was uneventful.

The patient's urine was examined once. The Cammidge reaction was positive, Y crystals being found. Both the phenylhydrazine hydrochloride and Fehling's tests were negative.

Case XXXII.—Female, white, aged forty-one years, without occupation, was admitted to the service of Dr. William R. Nicholson (16,829) with a diagnosis of double pyosalpingitis.

Family history, negative.

Previous history: Had measles during childhood; typhoid fever in 1907. She had two children, and no miscarriages.

Present condition: Patient had a severe pain in the lower abdomen, just after the cessation of menstruation. Under ether anesthesia a double salpingo-oöphorectomy was done. A small abscess formed in the line of the gauze drainage after the operation. The urine was examined once. The Cammidge reaction was positive, X crystals being found. Both the phenylhydrazine hydrochloride and Fehling's tests were negative.

Case XXXIII.—Male, colored, aged fifty-one years, without occupation, was admitted to the service of Dr. C. B. Farr (16,876) with a diagnosis of carcinoma of the liver.

Family history, negative.

Previous history: The patient had had mumps and whooping cough in childhood. He had gonorrhea and syphilis during his young manhood and was operated upon in 1902 or 1903 for stricture. He used to drink to excess and was a heavy smoker.

Present condition: The patient had complained of epigastric pain for a year. The pain followed taking food or water. It became so much worse three or four weeks ago as to prevent the taking of food. It radiated to the left shoulder. No nausea. The patient had lost about seventeen pounds in weight in three weeks and had lost strength. He had been constipated.

Physical examination showed marked arteriosclerosis; heart slightly enlarged to the right, and presented a weak systolic sound and accentuation of the aortic diastolic sound. The liver dulness extended from the upper border of the sixth rib to the eighth rib. From the eighth rib on the right side to the seventh rib on the left there was a distinct mass which moved with respiration. In the region of the gall-bladder this mass was nodular. There was a mass in the right iliac fossa. The abdomen was uniformly tender. The splenic dulness was replaced by tympany. A blood examination showed 5,050,000 erythrocytes, 8400 leukocytes, 78 per cent. hemoglobin. The differential count showed 58 per cent. polymorphonuclear neutrophiles, 33 per cent. lymphocytes, 5 per cent. large mononuclears, and 4 per cent. transitionals. After an Ewald test breakfast, 35 c.c. of gastric contents were removed. This showed 0.088 per cent. free hydrochloric acid, 64 total acidity, no lactic acid, and no Oppler-Boas bacilli. An examination of the feces showed occult blood, both by the aloin and the guaiac tests.

Under ether anesthesia an exploratory celiotomy was done, and the liver was found studded with carcinomatous nodules. The patient went progressively down and died of asthenia. The autopsy, made by Dr. James A. Kelly, showed carcinoma of the liver, the pancreas, the spleen, the peritoneum, and the prostate gland. The pancreas histologically showed, in addition to the carcinomatous nodules, areas of acute necrosis (Fig. 7).

The patient's urine was examined twice. The Cammidge reaction was positive on both occasions, X crystals being found. The phenylhydrazine hydrochloride test gave M crystals once and was negative once; Fehling's test was negative on both occasions.

Case XXXIV.—Male, white, aged forty-five years, waiter, was under treatment in the dispensary by Dr. C. B. Farr (176) for gastritis and cholangitis.

Family history, negative.

Previous history: He had been treated in the same dispensary in 1907 for catarrhal jaundice. Used alcohol to excess.

Present condition: He had been drinking heavily for three weeks, complained of pain and soreness in the stomach, vomiting after eating; no jaundice.

The patient's urine was examined once. The Cammidge reaction was positive, Y crystals being found. Both the phenylhydrazine hydrochloride test and Fehling's test were negative.

Case XXXV.—Male, colored, aged twelve years, schoolboy, was admitted to the service of Dr. David Riesman (16,883) with a diagnosis of typhoid fever.

Family history was negative, except that his mother and a sister were treated in the hospital at the same time for typhoid fever (16,891 and 16,892).

Previous history: The patient had already had the usual diseases of childhood, including diphtheria at the age of three years. He was subject to "colds," and had frequent attacks of nose-bleed and headache.

Present condition: The patient was admitted with a temperature of 102.2° F., which in sixteen hours was 104.8° F. He had been ill for three weeks with headache, epistaxis, diarrhea, and delirium. The agglutination test with the Bacillus typhosus was positive. He ran a severe course of typhoid fever, with hemorrhage, bedsore, nephritis, and an irregular temperature curve as complications. He died of exhaustion. There was no autopsy. His urine was examined once. The Cammidge reaction was positive, X crystals being found. The phenylhydrazine hydrochloride and Fehling's tests were both negative.

Case XXXVI.—Female, colored, aged thirty-nine years, housewife, was admitted to the service of Dr. David Riesman (16,891) with a diagnosis of typhoid fever.

Family history was negative, except that two of her children were being treated in the hospital at the same time for typhoid fever (16,883 and 16,892).

Previous history: The patient had had the usual diseases of childhood; pneumonia seven years ago, rheumatism one year ago. She had five children and two miscarriages.

Present condition: The patient was admitted with a temperature of 102.8° F. She had been sick for two weeks, complaining of anorexia, diarrhea, and headache. The agglutination test with Bacillus typhosus was reported indefinite. Her temperature ran an irregular course, and she recovered after an attack of left femoral phlebitis.

Her urine was examined once. The Cammidge reaction was positive, Y crystals being found. The phenylhydrazine hydrochloride test and Fehling's test were both negative.

Case XXXVII.—Female, colored, aged five years, was admitted to the service of Dr. James H. McKee (16,892) with a diagnosis of typhoid fever.

Family history was negative, except that her mother and a brother were treated in the hospital at the same time for typhoid fever (16,883 and 16,891).

Previous history: The child had had measles; she had an attack of pneumonia in 1908, and was subject to "colds."

Present condition: The patient was admitted with a temperature of 101.4° F. She had been ill for two months with headache, anorexia, and muscular and joint pains. She was said to have had pneumonia before she was admitted. The agglutination test with Bacillus typhosus was positive. The patient's temperature ran an irregular course, more suggestive of tuberculosis or sepsis than of typhoid fever. The von Pirquet tuberculin test was positive. She was taken home before she was considered ready to leave the hospital.

The patient's urine was examined once. The Cammidge reaction was negative. Both the phenylhydrazine hydrochloride test and Fehling's test were negative.

Case XXXVIII.—Female, white, aged thirty-two years, housewife, was admitted suffering from melancholia (16,895).

Family history, negative.

Previous history: She had had scarlet fever, measles, and chickenpox during childhood.

Present condition: The patient complained of various neurasthenic symptoms. There was no demonstrable organic disease. Her urine was examined once. The Cammidge reaction showed a very few X crystals. Both the phenylhydrazine hydrochloride and Fehling's tests were negative.

Case XXXIX.—Male, white, aged thirty-nine years, laborer, was admitted to the service of Dr. Morris Booth Miller (16,714) with a diagnosis of septic arthritis and ununited fracture of the patella.

Family history, negative.

Previous history: The patient was a heavy drinker. He had had the usual diseases of childhood.

Present condition: The patient was admitted for a fracture of the patella, which had occurred three weeks before. The patella had been fractured nineteen years before, but had never properly united. It had been sutured three months before the fresh accident refractured it. Pus was found coming from one of the stitch scars. Under ether anesthesia the knee-joint was opened and drained. The pus burrowed into the popliteal space, requiring one or two operations, several dressings under ether, and the application of casts. He was finally able to become an out-patient.

The patient's urine was examined twice. The Cammidge reaction was positive both times, X crystals being found. The phenylhydrazine hydrochloride test in the first examination gave a large number of spindle-shaped crystals, but no rosette forms; in the second examination the test was negative. Fehling's test was negative in both instances.

Case XL.—Male, white, aged twenty-five years, painter, was admitted to the service of Dr. John B. Roberts (16,910) with a diagnosis of inguinal hernia.

Family history, negative.

Previous history: Five years ago patient had stomach trouble; otherwise negative.

Present condition: A left oblique, inguinal hernia had developed four years ago, following the strain of lifting a heavy weight. Under ether anesthesia the operation of radical cure was done. The convalescence was uninterrupted. The patient's urine was examined once. The Cammidge reaction was positive, Y crystals being found. Both the phenylhydrazine hydrochloride and Fehling's tests were negative.

Case XLI.—Male, white, aged thirty-eight years, waiter, was being treated in the dispensary by Dr. C. B. Farr (616) for cirrhosis of the liver.

Family history, negative.

Previous history: The patient had been a heavy drinker up to eighteen months before he was first seen.

Present condition: The patient complained of soreness in the lower abdomen for four days. The soreness was increasing. He had a mitral systolic murmur

which was transmitted into the axilla; the aortic diastolic sound was accentuated. The liver dulness extended from the sixth rib to three fingers' breadth below the costal margin. The spleen was palpable. There was a stricture of the rectum. A blood count showed 4,600,000 erythrocytes, 7160 leukocytes, 94 per cent. hemoglobin. The differential count showed 60.2 per cent. polymorphonuclear neutrophiles, 27 per cent. lymphocytes, 3.6 per cent. large mononuclears, 3.6 per cent. transitionals, 4 per cent. eosinophiles, and 1.6 per cent. basophiles.

The patient's urine was examined once. The Cammidge reaction was positive, Y crystals being found. Both the phenylhydrazine hydrochloride and Fehling's tests were negative.

Case XLII.—Male, white, aged twenty-two years, laborer, was admitted to the service of Dr. John B. Roberts (16,904) with a diagnosis of burns of both thighs, legs, penis, and scrotum.

Family history was not obtained.

Previous history was not obtained.

Present condition: The patient was admitted with burns of both thighs, both legs, the penis, and the scrotum contracted at a fire in an iron foundry. He was etherized for the purpose of dressing, and made an uninterrupted recovery under the usual aseptic method of treatment with formaldehyde solution. The discharge from the burned surfaces seemed to be due to Bacillus pyocyaneus.

The patient's urine was examined twice. The Cammidge reaction was positive in both specimens, X crystals being found in the first and Y crystals in the second. The phenylhydrazine hydrochloride test was negative in the first, and M crystals were found in the second specimen. Fehling's test was negative in both specimens.

Case XLIII.—Male, white, aged thirty-three years, ice-cream maker, was a private patient, who had carcinoma of the stomach.

Family history: The patient's father died at the age of forty-five years from a "tumor in the side of the abdomen."

Previous history, negative.

Present condition: The patient had been suffering from indigestion for ten weeks. He vomited a washbasinful of watery material every three or four days; he had lost twenty-five to thirty pounds in weight; there was a tender mass, the size of a fist, at the pyloric end of the stomach. This mass was hard, nodular, and immovable. The peristaltic waves were plainly visible. The stomach tympany extended from the sixth rib to the umbilicus along the greater curvature. The liver was enlarged. An examination of the gastric contents forty minutes after the exhibition of an Ewald test meal showed the following: Quantity removed, 200 c.c.; total acidity, 32; free hydrochloric acid, absent lactic acid, present; Oppler-Boas bacilli present in large numbers; pepsin present. The feces contained occult blood. The Cammidge reaction was

positive, on one occasion Y crystals being found. The phenylhydrazine hydrochloride test and Fehling's test were not tried, because the amount of urine submitted for examination was too small. The patient died, but no autopsy was allowed.

Case XLIV.—Female, colored, aged fourteen years, schoolgirl, was admitted to the service of Dr. David Riesman (16,993) with a diagnosis of miliary tuberculosis.

Family history, negative.

Previous history: The patient had had measles and mumps.

Present condition. The patient was admitted with a temperature of 102.8° F. She had been ill for five days with headache and pain in the left side, made worse by taking a long breath, dyspnea, and rapid respiration.

The physical examination showed subcrepitant rales in the left chest, a left-sided pleural friction, and slight enlargement of the liver. The agglutination reaction with Bacillus typhosus was negative. She ran a markedly remittent temperature, her spleen became enlarged. An acute nephritis developed, as indicated by albumin, red blood corpuscles, and hyaline and granular casts in the urine. The apex of the right lung showed impaired resonance and numerous fine crackling rales, and fine crackling rales and prolonged expiration were heard over the upper lobe of the left lung. The pulmonary diastolic sound became accentuated. Subsequent agglutination tests with Bacillus typhosus were reported positive. The patient died of toxemia.

At the autopsy, made by Dr. J. A. Kelly, the following lesions were found: Acute miliary tuberculosis of the lungs, the liver, the spleen, the kidneys, the pleura, the peritoneum, the intestine, the suprarenal bodies, and of the peribronchial and abdominal lymph nodes. The pancreas was normal, both macroscopically and microscopically.

The patient's urine was examined once. The Cammidge reaction was negative, as were also the phenylhydrazine hydrochloride test and Fehling's test.

Case XLV.—Male, white, aged twenty-seven years, laborer, was admitted to the service of John B. Roberts (17,002) with a diagnosis of appendicitis.

Family history, negative.

Previous history: The patient had pneumonia in 1908.

Present condition: The patient complained of general abdominal pain of one month's duration. There was distention of the abdomen; no vomiting; the pain increased in severity; there was a tumor-like mass in the lower right quadrant of the abdomen, with tenderness. Under ether anesthesia an appendicular abscess was opened and drained. A second operation was done under ether anesthesia six weeks later and a retrocecal appendix was dissected out from its adhesions and removed. The wound continued to discharge after this second operation; the temperature curve being of the septic type. The wound showed no evidence of healing, and about one week later left thoracic pain developed, with pleural friction. Later, he had pain in the right chest. Still

later, physical examination showed a consolidation of the right apex. An examination of the sputum on two occasions failed to show tubercle bacilli.

The patient's urine was examined once. The Cammidge reaction was positive, Y crystals being found. The phenylhydrazine hydrochloride and Fehling's tests were negative.

Case XLVI.—Male, white, aged twelve years, schoolboy, was admitted to the service of Dr. David Riesman (17,020) with a diagnosis of typhoid fever.

Family history, negative.

Previous history: The patient had had measles, whooping-cough, and chickenpox.

Present condition: The patient was admitted with a temperature of 99.4° F. He had been sick for a week complaining of general headache, pain in the neck, and abdominal pain. He had diarrhea, anorexia, vomiting, slight cough, and was inclined to be delirious. The physical examination was negative. The agglutination test with Bacillus typhosus was positive. He ran an irregular temperature, with marked remissions, for two weeks, when convalescence began.

The patient's urine was examined once. The Cammidge reaction was negative. The phenylhydrazine hydrochloride and Fehling's tests were also negative.

Case XLVII.—Male, colored, aged twenty-four years, laborer, was admitted to the service of Dr. J. B. Roberts ((17,063) with a diagnosis of meningitis.

Family history, negative.

Previous history: The patient had pneumonia in 1908. Used alcohol and tobacco to excess.

Present condition: The patient was admitted semicomatose and with a temperature of 100° F. He had been taken ill suddenly with chill, headache, and vomiting the evening before admission. He had incontinence of urine and feces. The spleen was not enlarged, the abdomen was slightly tender, but no masses could be felt. The physical examination in general was negative. After a lumbar puncture a few intracellular diplococci were found in smear, stained with Löffler's methylene blue. The cells were nearly all polymorphonuclear in type with a few endothelial cells. Later, he developed an acute endocarditis of the mitral valve. He ran a markedly hectic temperature for about four weeks, and finally recovered.

The patient's urine was examined three times. The Cammidge reaction was positive on all three occasions, Y crystals being found at the first two and X crystals at the third examination. Fehling's test was always negative. The phenylhydrazine hydrochloride test gave M crystals at the second examination; the other two examinations were negative.

Case XLVIII.—Male, white, aged thirty-four years, teamster, was admitted to the service of Dr. David Riesman (17,163) with a diagnosis of chronic gastritis.

Family history, negative.

Previous history, negative.

Present condition: The patient was admitted complaining of pain in the stomach of eighteen months' duration. The pain began after eating and was attended by nausea. Anorexia and loss of weight were also present. An Ewald test breakfast was withdrawn in one hour, and showed absence of free hydrochloric acid, lactic acid present, no Oppler-Boas bacilli. A second examination gave the same results, with a total acidity of 60. A blood examination showed 4,850,000 erythrocytes and 7400 leukocytes.

The patient's urine was examined once. The Cammidge reaction was positive, Y crystals being found. The phenylhydrazine hydrochloride test gave M crystals. Fehling's test was negative.

Case XLIX.—Male, white, aged fifty-one years, engineer, was a private patient who had cholecystitis.

Family history, negative.

Previous history: The patient had an attack similar to the one for which he was treated at this time two years before.

Present condition: The patient complained of a dull ache in the upper part of the abdomen, with fulness, distress, and dyspnea after eating. Examination of the abdomen showed epigastric distention, tenderness in the upper quadrants, gall-bladder region tender. The gastric contents examined thirty minutes after the administration of an Ewald test breakfast showed no free hydrochloric acid.

The urine was examined once. The Cammidge reaction was positive, Y crystals being present. The phenylhydrazine hydrochloride test and Fehling's tests were both negative.

Dr. Gilbride operated upon the patient at the Methodist Hospital. The gall-bladder was distended; the pancreas was thicker and harder than normal; the stomach was normal; there were adhesions about the foramen of Winslow. The gall-bladder was drained externally. The drainage tube was removed in two weeks. The patient made a perfect recovery.

Case L.—Male, white, aged forty-seven years, carpenter, was a private patient, who had chronic pancreatitis.

Family history, negative.

Previous history: The patient had been bilious all his life. For ten years he had had an attack of fever every year; on one occasion he had a distinct attack of jaundice; on all occasions his skin was yellowish in color during the attack.

Present condition: The patient had had diarrhea for about seven months. Four months before he was first seen he had an attack of abdominal distention. There was pain in the upper abdomen, and he had lost fifteen pounds in weight. He had a systolic murmur, heard best at the apex of the heart. The examination of the abdomen showed tenderness over the gall-bladder region, and a sense of increased resistance in the upper quadrants. An examination of

the stomach contents removed thirty-five minutes after an Ewald test meal showed 10 c.c. total quantity removed; free hydrochloric acid, negative; total acidity, 50; pepsin, normal; no lactic acid.

The urine was examined once; the Cammidge reaction was positive, Y crystals being found. The phenylhydrazine hydrochloride test and Fehling's test for glucose were negative.

Dr. Gilbride operated on the patient in the Methodist Hospital. The pancreas was lobulated and harder than normal. The gall-bladder was distended with thick, dark colored bile. The stomach and the duodenum were normal. The gall-bladder was anastomosed to the duodenum about 1½ inches below the pyloric end of the stomach. The patient made a perfect operative recovery. The upper abdominal symptoms disappeared, but the diarrhea persisted.

Case LI.—Male, white, aged seventy years, without occupation, was admitted to the service of Dr. David Riesman (17,197) with a diagnosis of acute cholecystitis.

Family history, negative.

Previous history: The patient had had all of the diseases of childhood; he had a double inguinal hernia, and used alcohol and tobacco freely.

Present condition: The patient was admitted for indigestion of six years' duration. For the past month he had had pain and tenderness in the epigastrium after eating, with vomiting and loss of weight. An Ewald test breakfast was removed in one hour and showed absent free hydrochloric acid, total acidity 30; no Oppler-Boas bacilli. The stools were grayish in color; they did not contain occult blood. The physical examination showed jaundice, arteriosclerosis, tenderness, and fulness in the epigastrium, and internal hemorrhoids. A radiological examination made by Dr. Walter Estell Lee showed no stones either in the gall-bladder, the kidneys, or the ureter. No operation was done. The patient's urine was examined once. The Cammidge reaction was positive, Y crystals being found. The phenylhydrazine hydrochloride test and Fehling's test were both negative.

Case LII.—Male, white, aged twenty-seven years, clerk, was admitted to the service of Dr. J. B. Roberts (17,201) with a diagnosis of tuberculous adenitis.

Family history, negative.

Previous history: The patient had measles in childhood; abscess of the lung at the age of ten years; gonorrhea in 1901.

Present condition: The patient was admitted for an enlargement of the inguinal lymph nodes of one year's duration. Two weeks before admission, one of the nodes became much swollen and tender. Under ether anesthesia a mass of enlarged lymph nodes around the saphenous opening and a mass of lymph nodes from above Poupart's ligament were dissected out. The histological examination of these glands by Dr. James A. Kelly showed them to be a mixed-celled sarcoma. After the operation the patient had considerable sanguinolent discharge from the wound above Poupart's ligament. A blood

count showed 3,980,000 erythrocytes, 17,900 leukocytes, and 60 per cent. hemoglobin. Between two and three weeks after the operation recurrence was noticed in the wound in the thigh, and a week later the patient was sent to New York to be treated by Dr. Coley with the erysipelas and prodigiosus toxins.

The patient's urine was examined once. The Cammidge reaction was positive, X crystals being found. The phenylhydrazine hydrochloride test showed M crystals. Fehling's test was negative.

Case LIII.—Male, white, aged sixty years, musician, was admitted to the service of Dr. David Riesman (17,257) with a diagnosis of appendicitis.

Family history, negative.

Previous history, negative.

Present condition: The patient was admitted with pain in his right side in the region of the appendix, of two weeks' duration. The pain was referred to the inner side of the right leg. Physical examination showed rigidity of the right abdominal muscles and a mass in the right inguinal region. He lost flesh, and had a remittent temperature. Under ether anesthesia an appendicular abscess was opened and drained. The patient's arteries were moderately thickened.

The patient's urine was examined once. The Cammidge reaction was negative, as were also the phenylhydrazine hydrochloride and Fehling's tests.

TABLE II.—Results of Examinations

Serial No.	Hospital No.	Reaction.	Albumin	Fehling.	Phenylhydrazine.	Cammidge.	Clinical diagnosis.	Remarks.
1	16,247	Acid	—	?	××	+ X crystals	Varicose ulcer of leg	
		Acid	—	—	××	+ X crystals		
2	16,221	Acid	+	—	××	+ X crystals	Intestinal obstruction	
3	16,175	Acid	—	—	××	+ X crystals	Fracture of leg	
		Acid	—	—	××	+ X crystals		
		Alkaline	—	—	××	+ X crystals		Cammidge A reaction.
		Alkaline	—	—	××	+ X crystals		Cammidge B reaction.
		Alkaline	—	—	××	+ X crystals		Cammidge C reaction.
4	Private case	Acid	—	—	××	—	Pernicious anæmia	
5	16,377	Acid	—	—	××	+ Y crystals	Chronic pancreatitis	
		Acid	—	—	××	+ Y crystals		
		××	×××	×××	××	+ Y crystals		
		××	××	××	—	—		Small specimen of urine submitted.
		Acid	—	—	××	—		
6	Private case	Acid	—	+	××	+ X crystals	Cholecystitis	Operation.
		××	—	—	××	—		
		××	××	××	××	+ X crystals		
		Alkaline	—	—	M	+ X crystals		
		Acid	—	—	M	+ Y crystals		
		Acid	—	—	—	+ Y crystals		
		Acid	—	—	—	+ Y crystals		
7	Private case, 711	Neutral	—	—	××	+	Pancreatitis	A reaction.
		××	—	—	××	—		
		Acid	—	—	—	+ Y crystals		No operation.
8	16,419	××	—	—	M	—	Foreign body in thigh	
9	16,215	××	0.3%	—	××	—	Osteoarthritis	
10	Private case, 717	××	—	—	—	—	Subacute gastritis	
11	16,490	Acid	—	—	M	+ X crystals	Paratyphoid fever	
		Acid	—	—	M	+ X crystals		
12	16,499	Acid	—	—	M	+ Y crystals	Crushed leg	
13	16,529	Acid	—	—	M	+ Y crystals	Carcinoma of pancreas	Patient died, no autopsy.
		Alkaline	—	—	××	+ Y crystals		
		Acid	—	—	M	+ X crystals		
14	16,519	Acid	—	—	M	+ Y crystals	Hernia	Operation.
		Acid	—	—	M	+ Y crystals		
15	16,518	Acid	—	—	M	+ Y crystals	Typhoid fever	
		Acid	—	—	M	+ X crystals		
16	16,583	Acid	+	—	Lost	+ X crystals (?)	Typhoid fever	
		××	+	—	M	+ Y crystals		
17	16,579	××	—	—	Lost	+ Y crystals	Valvular heart disease, and dropsy	
		××	—	—	M	+ Y crystals		
18	16,578	××	—	—	M	+ X crystals	Cholecystitis	
		××	—	—	M	+ X crystals		

	16,372	Acid	—	—	M	+ X crystals	Fracture of femur	
19	16,633	Acid	—	—	M	+ X crystals	Influenza	
20	16,634	Acid	Trace	—	M	Maltosazone crystals	Myocarditis	
21								
22	16,599	Acid	—	—	M	+ X crystals	Typhoid fever	
23	16,678	Acid	—	—	M	+ Y crystals	Inguinal sinus	Indican; few hyaline casts.
24	16,745	Acid	—	—	—	+ Y crystals	Galactocele	
25	16,753	Acid	—	—	M	+ X and Y crystals	Lobar pneumonia	
26	16,762	Acid	—	—	—	+ Y crystals	Pott's fracture	
27	16,799	Acid	Trace	—	—	+ X crystals	Septic peritonitis and empyema	
28	16,825	Acid	—	—	—	+ X crystals	Hemoptysis	Phosphates.
29	16,827	Acid	—	—	—	+ Y crystals	Fibroid uterus	Phosphates.
30	16,777	Acid	Trace	—	—	+ Y crystals	Dermoid cyst of ovary	Blood corpuscles.
31	16,729	Acid	—	—	—	+ Y crystals	Laceration of pelvic floor	
32	16,829	Acid	—	—	—	+ X crystals	Double pyosalpingitis	
33	16,876	Acid	—	—	M	+ X crystals	Carcinoma of liver	Carcinoma of pancreas.
		Acid	—	—	—	+ X crystals		
34	Stomach dispensary, 176	Acid	—	—	—	+ Y crystals	Gastritis and cholangitis	
35	16,883	Acid	Trace	—	—	+ X crystals	Typhoid fever	Renal epithelium and casts
36	16,891	Acid	—	—	—	+ Y crystals	Typhoid fever	
37	16,892	Acid	—	—	—	—	Typhoid fever	
38	26,895	Acid	—	—	—	Very few X crystals	Insanity; acetanilid poisoning	
39	16,714	Acid	—	—	?	+ X crystals	Septic arthritis	Phenylhydrazin test showed large number of spindle-shaped crystals, but no rosette forms.
		Acid	—	—	—	+ X crystals		
40	16,910	Acid	—	—	—	+ Y crystals	Inguinal hernia	
41	Stomach, 616	Acid	—	—	—	+ Y crystals	Cirrhosis of liver	
42	16,904	Acid	—	—	—	+ X crystals	Burns of thighs	
		Acid	—	—	M	+ Y crystals		
43	Private case	Acid	××	××	××	+ Y crystals	Carcinoma of stomach	Urine submitted not enough to do anything but Cammidge.
44	16,993	Acid	—	—	—	—	Miliary tuberculosis	
45	17,002	Acid	—	—	—	+ Y crystals	Appendicitis	
46	17,020	Neutral	—	—	—	—	Typhoid fever	
47	17,063	Alkaline	—	—	—	+ Y crystals	Cerebrospinal meningitis	
		Acid	—	—	M	+ Y crystals		
		Alkaline	—	—	—	+ X crystals		
48	17,163	Acid	—	—	M	+ Y crystals	Chronic gastritis	
49	Private case	Acid	—	—	—	+ Y crystals	Cholecystitis	
50	Private case	Acid	—	—	—	+ Y crystals	Pancreatitis and cholecystitis	
51	17,197	Acid	—	—	—	+ Y crystals	Acute cholecystitis	
52	17,201	Acid	—	—	M	+ X crystals	Sarcoma of inguinal lymph nodes	
53	17,257	Acid	—	—	—	—	Appendicitis	

×× = test not made.

We wish to take this opportunity to thank Dr. John B. Roberts, Dr. L. W. Steinbach, Dr. J. M. Baldy, Dr. James K. Young, Dr. A. A. Eshner, Dr. Morris Booth Miller, Dr. David Riesman, Dr. J. H. McKee, Dr. William R. Nicholson, Dr. Francis T. Stewart, and Dr. C. B. Farr for their courtesy in providing the clinical material used in this work, and for permission to use the clinical records of the patients.

REFERENCES

1. P. J. Cammidge. Lancet, March 19, 1904.
2. A. W. Mayo Robson and P. J. Cammidge. The Pancreas, its Surgery and Pathology, 1907.
3. J. Henry Schroeder. Journal of the American Medical Association, September 5, 1908.
4. Watson. British Medical Journal, April 11, 1908.
5. Edgecombe. Practitioner, February, 1908.
6. Edward H. Goodman. Annals of Surgery, February, 1909.
7. Edward H. Goodman. International Clinics, July, 1909, 19th series, vol. ii.
8. John Speese and Edward H. Goodman. American Journal of the Medical Sciences, January, 1909.
9. John Speese and Edward H. Goodman. Ibid., July, 1909.
10. Eichler. Berliner klinische Wochenschrift, June 24, 1907.
11. L. Caro and E. Wörner. Ibid., February 22, 1909.
12. L. Eloesser. Mitteilungen aus den Grenzgebieten der Medizin und Chirurgie, vol. xviii, part 2.
13. W. H. Willcox. Lancet, July 23, 1904.
14. P. J. Cammidge. Ibid., June 18, 1904, p. 1750.
15 Bushnell. Ibid., June 11, 1904.
16. G. Fiorio and G. Zambelli. Il Morgagni, September, 1908.
17. P. J. Cammidge. British Medical Journal, May 19, 1906.
18. Francis P. Kinnicutt. Medical Record, April 10, 1909.
19. A. M. Kellas and Frank J. Wethered. Lancet, October 20 and 27, 1906.
20. Jaffé. Zeitschrift für physikalische Chemie, vol. xxii.
21. P. S. Haldane. Edinburgh Medical Journal, 1906, lxii, 418.
22. Ham and Cleland. British Medical Journal, June 4, 1904.
23. O. C. Gruner. Ibid., June 25, 1904.
24. A. E. Taylor. Lancet, June 30, 1906.
25. J. E. Schmidt. Mitteilungen aus den Grenzgebieten der Medizin und Chirurgie, 1909, vol. xx, No. 37.

DISCUSSION

Dr. Edward H. Goodman: A mistake that was brought out in the beginning of Cammidge's work and later met with by observers was that of laying too much stress on the clinical diagnosis from the laboratory findings. Cammidge himself is drawing away from that view. The reaction is only, at the best, suggestive, and not pathognomonic. I have found it in gastroptosis, diabetes, and in carcinoma of the pancreas, where, theoretically, it does not occur, and in other conditions. In certain diabetic cases where the pancreatic reaction

has been made after fermentation I have found positive Cammidge reaction in three cases.

Dr. William H. Welker: In experimenting with this test, Dr. John Marshall and I obtained positive results with urine from several apparently normal individuals. This observation had been made by others previous to our work and confirmed by the recent work of Maass, Klauber, Kreinitz, Grimbert, Bernier, and Smolenski.

A test like the one under discussion will always be regarded with suspicion by the chemist, for the reason that in the first place phenylhydrazine forms an almost endless variety of combinations with other chemical compounds of many different types. Further, normal urine is also a very complex mixture, containing, in all probability, varying small quantities of quite a few compounds not as yet recognized. And finally, making matters still worse, considerable quantities of various chemical reagents are added in carrying out the test.

A great deal of stress has been laid on the melting point determination as a means of differentiating between the various osazones. Dr. Marshall studied the melting points of various osazones that I prepared from chemically pure materials and found widely differing results. In reading some of Fischer's articles on carbohydrates, I found that glucosazone, the most easily prepared osazone, was ascribed melting points between 204° and 230° C. by various investigators. Fischer in reviewing this work states that rapidity of heating makes a very considerable difference in the melting point of glucosazone; and also that phenylhydrazine or phenylhydrazine hydrochloride, which are both rather unstable, must be purified before pure glucosazone can be obtained. In view of these facts, it can be easily seen that no dependence can be placed on the melting point of osazones obtained from urine even when these osazones have been recrystallized several times.

The presence of maltose or lactose in the urine in such small quantities that the phenylhydrazine test will not show any crystals of the osazones of these sugars may result in a positive Cammidge test because the boiling with HCl will hydrolyze them into monosaccharids, and the osazones of these compounds are less soluble and therefore will crystallize and yield the typical Cammidge crystals.

Sucrose, if present, will not respond to the phenylhydrazine test, but on hydrolysis in the Cammidge test will also yield the Cammidge crystals.

It is easy to see how a very slight amount of glucose could be present and be too small in quantity to yield osazone crystals with the phenylhydrazine test, and that this same quantity of glucose in the Cammidge test would show crystals because of the removal of substances interfering with crystallization and also because of the increased concentration of the solution, due to the added chemicals.

According to a recent investigation glucose cannot be quantitatively removed from urine by fermentation. If this is the case, Cammidge's suggestion to remove glucose, when present, by fermentation with yeast might also lead to error.

Maltose has been proved a possible fallacy by the experiment mentioned by Dr. John M. Swan.

Smolenski has definitely shown that in a case showing a positive Cammidge reaction it was due to sucrose. This investigator not only proved this by chemical tests, but also by the isolation of the sucrose itself from this urine.

Grimbert and Bernier, after a long series of experiments on this test, have come to the following conclusion: "The substance hydrolyzed exists normally in the urine, and the Cammidge reaction is of no clinical significance."

The known fallacies for this test are sucrose, small quantities of maltose or lactose, and possibly very small quantities of glucose. Our information as to the occurrence of carbohydrates in the urine other than glucose is very slight. The conclusion reached by Cammidge in his latest article is that the reaction is due to change in the pancreas only and not to changes in any other organs. This is a rather startling conclusion when we view all the possible fallacies. The test has absolutely no clinical value unless in each case the carbohydrate material responsible for the positive reaction is isolated, and definitely proved to be none of the possible fallacies.

Dr. Swan, closing: I think Dr. Goodman's questions have been answered. We think maltose may give the Cammidge reaction, because, in a specimen of urine known not to show that reaction, the addition of maltose in proportion of 0.05 per cent. was followed by the formation of typical Cammidge crystals on performing the Cammidge test; in the phenylhydrazine hydrochloride test, on the contrary, no maltosazone crystals could be discovered.

In performing the phenylhydrazine hydrochloride test we think it necessary to let the tube stand over night before pipetting off the sediment for the determination of osazone crystals. If the sediment is examined as soon as the contents of the tube are cool, small quantities of osazone may be missed.

SYMPTOMATIC RELIEF IN AORTIC ANEURYSM BY WIRING AND GALVANISM (MOORE-CONRADI METHOD)*

By E. J. G. BEARDSLEY, M.D., L.R.C.P. (London)
CHIEF OF THE OUT-PATIENT MEDICAL DEPARTMENT OF THE JEFFERSON MEDICAL COLLEGE HOSPITAL OF PHILADELPHIA; ASSISTANT PHYSICIAN TO THE PHILADELPHIA HOSPITAL

Before reporting the two instances in which the Moore-Corradi method of treatment was used by us, it may be of interest to briefly review both the ancient and modern treatment of thoracic aneurysm. It is noteworthy that although aneurysms, thoracic and otherwise, were recognized and studied centuries ago, there has never been discovered a satisfactory treatment for the condition. It is true that radical surgical measures are used successfully when peripheral arteries are affected, but treatment by the application of the ligature is seldom, if ever, applicable to thoracic aneurysm.

From the earliest times until the present day, the object sought in the treatment of this condition was to bring about coagulation of the blood within the aneurysmal sac and thus cause a cure.

It was early pointed out by Valsalva and other observers that in order to hasten the coagulation it was essential that the patient should be placed at rest in bed and that all muscular effort should be reduced to a minimum. The object of the recumbent position was to reduce the number and force of the cardiac contractions that control the flow of blood through the sac. It was Valsalva, also, that advocated a restricted diet and frequent venesections to accomplish the same purpose; but Bellingham[1] warned the pro-

* Read February 2, 1910. Patient exhibited by Beardsley, Rhoads, and Saurmann.

fession against bleeding in this condition, and reported more satisfactory results without its aid.

Tufnell,[2] of Dublin, in 1875, revived interest in the treatment advocated by Valsalva and Bellingham, and the modern medical treatment of aneurysm by rest and restricted diet is commonly known as the Tufnell treatment. This well-known and commonly employed treatment consists in placing the patient at absolute rest for a prolonged period, during which time the diet, particularly the fluid portion, is much restricted. The object of this reduction of diet is to reduce the blood pressure as well as the volume of blood, and at the same time to increase the coagulability of the blood by increasing the amount of its fibrin.

The diet advised by Tufnell is as follows:

For breakfast, two ounces of bread, with butter, and two ounces of milk; for dinner, two or three ounces of meat and three or four ounces of milk or claret; for supper, two ounces of bread and two ounces of milk.

Balfour[3] found that he obtained much better results if he administered to the patient who was undergoing the rest treatment fifteen grains of potassium iodide three or four times a day, and many observers have confirmed this observation. The iodide is apparently useful whether the patient has a specific history or not, and is supposed to reduce the blood pressure as well as to increase the viscosity of the blood. Whether the drug accomplishes these actions or not, many physicians are agreed that the drug does decrease the pain and discomfort which is so frequently a marked symptom in the disease.

In conjunction with the rest treatment it has been found advisable to use other drugs, such as aconite, veratrum viride, and other circulatory sedatives, while, unfortunately, it is also necessary in the majority of the patients to use freely the opium derivatives for the relief of pain. To sum up the results of medical treatment in this condition, we find that in the majority of the patients who suffer from aneurysm, medical treatment avails little, except to mitigate the pain and in a feeble way to retard the progress of the condition. It is to be remembered, however, that the prognosis in this con-

dition is most difficult and that the progress of aneurysm, in many patients, is very slow, while in others the condition is rendered latent by the sac becoming filled with clot, and this latter state appears to occur as frequently in the untreated as in those who remain under treatment.

The surgical measures of treatment, although more promising, are far from satisfactory as far as ultimate cure is concerned.

A method of treatment, once popular but now abandoned, was introduced by Cinicelli,[4] who introduced within the sac two needles which were connected with a galvanic battery. This treatment was first suggested by Velpeau,[5] and about the same time by Phillips.[6] It was tried by several men, but the results were not satisfactory.

Macewen[7] advocated the introduction of needles and the scratching of the inner lining of the aneurysmal sac, with the hope that the irritation would cause thrombus formation; but later observers have not been impressed by either the theory or the method of procedure. Another method of treatment was proposed and carried out by Moore, a surgeon of the Middlesex Hospital, London, who was the first to attempt the cure of an aortic aneurysm by the introduction of a permanent foreign body. In his first operation he used steel wire, introducing over seventy feet, and although the patient died of sepsis, Moore afterward stated in his report that "if there be no manifest and essential fault in the procedure, I cannot think it right to abandon an operation which was so promptly followed by most marked and positive improvement."

Following the first attempt at wiring, which proved a failure as far as the preservation of life was concerned, Moore advocated that less wire be used in the operation and that it be so manipulated that it would coil in the cavity of the sac. Following this introduction of a foreign body within the aneurysmal sac by Moore, other foreign bodies have been used for the same purpose. Horsehair, catgut, watch springs, silk thread, and gold and silver wire have been used by different surgeons.

Lancereaux,[8] in 1897, advocated another method of treatment. This was the subcutaneous injection of gelatine dissolved in normal

salt solution. The injection was given into the loose cellular tissues at some distance from the aneurysm and was supposed to increase the coagulability of the blood. The treatment has proved disappointing in the hands of most observers.

Freitas[9] claims excellent results for a method which he terms the "Brazilian method." This method consists in applying galvanism to the area over the aneurysm. There can be no doubt that the application of galvanism in this way relieves the patient of much pain and discomfort, and in those patients who refuse operative help it is a most useful measure, but is scarcely a method which is likely to bring about a cure of the condition. The last treatment that it seems necessary to mention is the one that proves most satisfactory in those cases in which it can be applied. The method is a combination of the procedure advocated by Moore (the introduction of a foreign body within the sac) and the application of a galvanic current of electricity for the purpose of coagulating the blood within the sac and upon the foreign body. Corradi, in 1879, suggested this combination treatment, and since that date many patients have been so treated, with good symptomatic cures.

Two of the patients upon whom the Moore-Corradi method of treatment was successfully applied were seen in the wards of Dr. Samuel Rhoads at the Philadelphia General Hospital, by whose permission the cases are reported, while the last patient reported was under the care of Dr. Evan Evans, at the Roosevelt Hospital, New York City, and through whose courtesy and the courtesy of Dr. E. T. Rulison, of the hospital staff, I am able to report the case as a personal communication.

The first patient to be reported is J. P., a negro, aged fifty-seven years. His family history is unreliable. His past medical history reveals little of interest except two things. The first is that the patient has worked very hard all his life and has lived very hard also. He worked until he was twenty-one as a farmhand, and since that time has been employed as a teamster, 'longshoreman, and roustabout. During the past twenty years the patient has been what he terms "a steady, hard drinker." Fifteen years ago he contracted gonorrhea, and about the same time had a sore on his

penis, which was later followed by a general rash. At this time he was employed on board a cattle boat, and he consulted a physician in one of the ports, who informed him that he had syphilis, and who instituted treatment. The medicine was taken faithfully until the rash and chancre disappeared, and no specific medicine has been taken since that time. The patient states that he has never had sore throat nor has he suffered from bone pain. He states that his present illness dates from three years ago, when he first noticed that he was "short of breath," and could not do his work properly. He had at this time much pain in his chest, a very distressing cough, and periods of hoarseness, which varied in duration, sometimes lasting a week and at other times disappearing in a few hours.

Sixteen months ago the patient noticed for the first time a small lump in the upper third of the left chest, which lump was painful and tender. The pain increased in severity and at times would radiate down the left arm, and, more rarely, would be felt in the left side of the neck. For four months the patient could only sleep when upon the left side. If he attempted to sleep upon the right side or upon his back he would at once suffer from severe pain and would have a cough.

The patient entered Dr. Rhoads' wards on October 3, 1909. He at this time complained bitterly of pain in the upper portion of his left chest, which pain radiated both into his left arm and into the left side of his neck. The pain was so severe that the patient could get no rest, and it was found necessary to administer opium for its relief. A constant irritating cough, which was unproductive, added greatly to the patient's discomfort.

Physical examination at this time revealed a pulsating mass about the size of a pigeon's egg, located in the third left interspace close to the sternum, and over this area a loud bruit could at times be heard, while at other times there was present a blowing systolic murmur. The radiographic examination revealed an abnormal shadow in this region, which was quite plainly a sacculated aortic aneurysm.

As the patient failed to improve, under the usual medicinal treat-

ment, and as the pain was steadily increasing, it was determined to wire the sac by the Moore-Corradi method.

On Novemeber 1, 1909, the patient's chest was prepared and a few drops of 1 per cent. cocaine solution injected under the skin over the pulsating mass. After a moment's delay, for the anesthetic to take effect, a nick was made in the skin to allow a properly insulated needle to enter. This hollow needle was plunged into the softest portion of the aneurysmal mass by Dr. Rhoads, and after a slight spurt of blood and the trickling of a small amount from the needle, the sterilized gold wire (No. 26) was introduced into the aneurysmal sac through the hollow needle. We coiled thirty-two feet of the wire within the sac and then attached the end to the positive pole of a galvanic battery, so arranged that the current could be controlled to very small amounts. The negative pole of the battery was attached to a moistened pad, which was placed beneath the buttocks of the patient.

Starting with 5 milliampéres for five minutes, and then slowly increasing the amount in quantities of 10 milliampères at a time until 60 was reached, and then slowly decreasing the current at intervals until the zero mark was reached. The introduction of the wire and the application of the electrical current were practically painless. During the operation the patient expressed himself as believing that the pain in his chest was lessened before the current had been passing ten minutes. The current was allowed to pass through the wire for one hour, and at the end of that time there was practically no expansion of the mass, while over this area there was a feeling of much greater resistance than before the wiring. There was a slight difficulty in removing the needle, as is often the case, but this was done by loosening it by turning it slowly, and it was then withdrawn. A slight oozing of blood followed, which caused a good-sized hematoma, but this disappeared in a short time.

The patient expressed himself as greatly relieved by the procedure, and noticed that he could lie on either side or on his back without producing pain. The patient remained in bed three weeks, and then was allowed to be about the ward. After a period

of several weeks, during which time he acted as orderly in the hospital, he was discharged. Two months after the wiring, during which time the patient had been attempting to work at heavy labor, the patient applied for admission to the Jefferson Medical College Hospital, where he was given a place in the wards as a "demonstration case."

At this time there was slight pulsation in the aneurysmal sac, but no bruit could be heard. The patient was discharged from the hospital after a few weeks, and was not seen for several months. During this period he made a precarious living by doing "odd jobs" about the wharves. Wishing to visit some friends, and not having the money for car fare, he walked most of the distance and back. This long walk (sixty miles), especially as during this time he had little food and that at uncertain times, brought on a persistent pain in the region of the aneurysmal mass. He was again admitted to the Philadelphia General Hospital, where it was found that his symptoms disappeared after a few days in bed. This was in September, 1910, and at this time there seemed to be slightly more pulsation in the third left interspace than there was when he left the Jefferson Medical College Hospital wards seven months before.

At the present time (November 15, 1910) the patient is free from pain and discomfort as long as he does not exercise too freely, but after a hurried walk he complains of pain in his left side and occasionally of pain under his left scapula, as well as radiating pain in his left arm. When we consider that the patient has passed over a year since his operation, in comparative comfort and the greater part of the time without symptoms, it must be agreed that the wiring operation did, in all probability, add months to his life and gave him a pain-free year.

The second case to be reported is that of W. C., aged thirty-seven years, a negro. The patient's family history is unimportant. He had an attack of rheumatism at twelve years of age and scarlet fever at eighteen. He denied venereal disease of any kind, but admitted many exposures to such disorders.

He was a farm laborer in his younger years, and following this period did the hardest kind of work in lumber- and brickyards and

as a 'longshoreman. Two years before he entered the wards of the Philadelphia General Hospital he began to suffer with pains in his chest and back. Sometime she was compelled to stop work for several days because of the shortness of breath. He worked "off and on" at the wharves until he entered the hospital.

When seen in Dr. Rhoads' wards, this patient had a large bulging mass over the second and third right interspace, which showed decided expansile pulsation and over which a loud continuous bruit could at times be heard. At other times there could be heard a systolic murmur, and at other times the murmur was diastolic in time.

The radiographic examination revealed that there was apparently a sacculated aneurysm of the ascending portion of the arch of the aorta. The patient complained of continuous pain in his right upper chest and occasionally of a severe shooting pain into his right arm and into the right side of his neck.

Dr. H. A. Hare, who has had a very large experience with the wiring operation, and who has probably used this procedure more often than any other man, was good enough to see the patient with us and confirmed our opinion as to the advisability of the operation, and also assisted us in the wiring, which was done on October 24, 1909, by Dr. J. Shelley Saurmann, interne in Dr. Rhoads' wards.

The technique was the same as in Case I, except that less wire was used. We used only eighteen feet in this instance. Its introduction caused little pain, and the patient remarked that his pain was less shortly after the current was applied. Subsequent to the operation the patient remained in the hospital seven weeks, during which time he complained of no discomfort or pain except after exercise.

He was discharged on November 26, 1909, improved in every way, but there was still light pulsation in the mass, and this pulsation was slightly expansile.

A few weeks after the discharge of this patient from the Philadelphia Hospital he was admitted to the Jefferson College Hospital, partly to give him a place to remain without the necessity of working and in part that he might be demonstrated to the students. A

few weeks after his admission he began to complain of pain in the region of the slightly expansile mass and at the same time he complained of difficulty in breathing. In order to relieve the pain the sac was wired for the second time by Dr. H. A. Hare. This was done on January 27, 1910, about three months after the first wiring. Only nine feet of wire were introduced at this time, and the patient complained of discomfort and pain while the current was passing. Following the operation, the patient was more comfortable for about ten days, and then the tumor began to markedly enlarge and the pain became severe. The measurements of the mass at this time were ten and a half inches horizontally and eight and a half vertically. The patient was kept under the influence of opiates until February 21, 1910, when the sac ruptured externally.

At autopsy it was discovered that the true aneurysm was fusiform and not sacculated, as had been thought, and that the large pulsating mass which was wired was a false aneurysm, which had resulted from the gradual perforation and escape of the blood from the fusiform aueurysm. This explains why the results of the procedure in the second patient were less favorable than in the first. It has been often pointed out that there is little to be hoped for in wiring a fusiform aneurysm.

However, in both the cases recorded the patients expressed satisfaction with the operation, and each declared that they would gladly endure the discomfort of the wiring operation to have the freedom from pain and distress that followed.

The third patient is J. L., aged forty-seven years, white; clerk. Family history unimportant. He denied having had syphilis, but stated that he suffered from gonorrhea nineteen years before his present symptoms appeared.

In 1904 this patient began to suffer from severe pain in his right chest and in the right arm from elbow distally. There was marked visible pulsation to right of sternum between second and fourth ribs; corresponding to this area, there was a systolic thrill, while on auscultation a blowing systolic murmur could be heard. Radiographic examination revealed a large shadow to the right of the ternum. In 1906 the patient was treated at the Post-Graduate

Hospital in New York by electrolysis, needles being inserted on several occasions. He remained symptom-free for seven months. He then began to cough, and have pain in his right chest. In 1908 he was re-admitted to hospital, having a large oval swelling, three by three and a half inches in diameter, which was visibly pulsating. He was given a prolonged rest and left the hospital improved. He entered the Metropolitan Hospital in 1909, and the aneurysm was here wired by the Moore-Corradi method. The current was applied in the usual way on several different occasions. After leaving the hospital he resumed his work as clerk in a publishing house and was able to work until December, 1909, when he began to suffer pain. He was admitted to the Roosevelt Hospital on December 23, 1909, and again on April 26, 1910. This last admission was a few days before his death. He died of exhaustion on April 27, 1910.

Autopsy report: "As sternum with costal attachments was lifted the sac of the aneurysm was found firmly attached to the right side and to the costal cartilages of second, third, and fourth ribs. Adjacent structures—heart, lungs, etc.—removed *en masse*. On dissection of sac and arch of aorta a coil of several feet of silver wire was found, the greater portion being free in the lumen of the ascending aorta, one strand extending through arch and was fused to wall of descending portion. The wall of the sac is extremely thin, but is lined by a dense deposit of fibrin one-quarter of an inch thick. The wall of the ascending aorta shows many calcareous plaques."

Eshner[10] has recently reviewed the literature upon the subject of the Moore-Corradi method of treatment and was able to give a *résumé* of 38 cases. He found that 22 of the 38 patients treated by this method died within a year following, but also found that in a very large percentage of these patients that they were far more comfortable after the operation and had for a period freedom from pain.

One patient is known to have lived three and a half years following the operation; another, five; another, three; and still another eleven years and eight months.

There can be little doubt that the wiring operation would show much better results if it were performed before the patient's strength had been exhausted by weeks and months of pain. The prognosis will become much better when the operation is done before the expansile tumor has reached a large size, and should be done as soon as an aneurysmal sac is located in a position which can be reached by the hollow needle.

The operation is so simple and so free from pain as well as free from serious danger, that it would seem to deserve more frequent use than it receives.

It is to be remembered that the simple introduction of sterilized gold or silver wire within an aneurysmal sac will often cause much relief from pressure symptoms. This was shown in those patients treated by the introduction of foreign bodies without the administration of galvanism, and has recently been emphasized by Anders and Mann,[11] whose patient received much relief from such an introduction of wire without galvanism and who was living and free from symptoms thirteen months after the operation.

The most helpful papers upon the subject of the Moore-Corradi treatment are those by Stewart,[12] Stewart and Sallinger,[13] Stewart,[14] Hunner,[16] and Hare.[16]

BIBLIOGRAPHY

1. Bellingham. Dublin Medical Press, xxvii, p. 81.
2. Tufnell. A pamphlet, London, 1875.
3. Balfour. Clinical Lectures on Diseases of the Heart and Aorta, 3d ed.
4. Cinicelli. Gaz. des Hôpitaux, 1868.
5. Velpeau. Medical Gazette, 1831, vii.
6. Phillips. A pamphlet, 1832.
7. Macewen. Lancet, 1890, ii, 1086.
8. Lancereaux. Bull. de l'Acad. de Paris, 1897.
9. Freitas. Brazil Medico, November 22, 1909.
10. Eshner. American Journal of the Medical Sciences, October, 1910.
11. Anders and Mann. Journal of the American Medical Association, May 23, 1908.
12. Transactions of the College of Physicians of Philadelphia, 1892. xiv, 68.
13. Stewart and Sallinger. American Journal of the Medical Sciences, 1896, cxii, 171.
14. Stewart. Philadelphia Medical Journal, November 12, 1898.
15. Hunner. Bulletin Johns Hopkins Hospital, November, 1900, p. 263.
16. Hare. Therapeutic Gazette, 1898, p. 293; ibid., 1900, p. 9; ibid., 1900, p.510; ibid. 1903, p. 19; ibid., 1905, p. 433.

DISCUSSION

Dr. H. A. Hare: Of two cases which came under my care in the Jefferson Hospital, treated by electrolysis and wiring, one was a most typical case of a very large aneurysm, extending outside the wall of the chest to a space greater than the depth of my fist with the thumb extended. The patient was to have been brought here tonight, but developed a temperature of 102° and a high pulse rate because of some pulmonary complication. I have brought with me a series of photographs of other cases that I have wired which I think will be of interest.

I do not think that it is necessary for me to say much in addition to what Dr. Beardsley has said regarding the extraordinary relief of pain and tension following this operation. I am in doubt as to what the cause of the sudden relief is. I suppose those who are enthusiastic electrotherapeutists would say that it is due to the sedative effect of the galvanic current. I am not a sufficiently enthusiastic electrotherapeutist to have much confidence in that belief. As a rule, within five or ten minutes after the current begins to pass through the sac there is a marked diminution in the expansile pulsation and of the great resistance to the fingers. I have wired an aneurysm of the aorta 16 times, and think I am correct in saying that 12 out of the 16 voluntarily stated that the pain was better before any question on this point was addressed to them. Dr. J. Chalmers Da Costa will recall a case which he and I had together two years ago, in which the patient, a colored man, voluntarily stated that the pain was remarkably diminished. While the aneurysm is not cured in one sense, any method which gives so much relief is justified in the great majority of cases. There are cases, however, in which it is contraindicated, as in fusiform aneurysm. We know that the operation does prolong life. Most of you are familiar with the notable case of the late Dr. D. D. Stewart, whose case had an aneurysm of the aorta and innominate artery, which was wired twice by Dr. Stewart and lived for three years without any increase. The autopsy showed that the aneurysm had apparently healed. In my experience I have never seen life prolonged to such a period, the periods varying from six weeks to eighteen months.

The great underlying difficulty is that the conditions are similar to those in dealing with a piece of rotten hose. If the vessel is atheromatous, we are almost sure to get the growth of an aneurysm in another direction. All of my cases died of pressure symptoms—none of rupture. This is interesting because in a number of cases in which wiring has been done rupture has seemed so threatening that it seemed almost as if one were taking the man's life to introduce wire. In three cases there was weeping of blood, the skin being discolored and somewhat ecchymotic. In the case of wiring of an aneurysm of the innominate artery which I performed, no trace of the wire could be

found at autopsy, although there were 32 feet of wire introduced. An important point to remember is that a fusiform aneurysm must not be wired. Another point of very great importance is to see that the positive pole is attached to the wire. If the negative pole is attached, an alkaline reaction occurs and a solution of the clot follows; if the positive pole is attached, a coagulation of the clot occurs. In one instance I know of the negative pole was attached, and within four or five minutes emboli were carried into various portions of the circulation. Another danger is the possibility of puncturing the sac without causing it to rupture. There is an unreported case in Boston in which the patient passed away on the table. This is the only case of which I have heard in which an accident happened. In one of my cases wiring was done three times, the idea being to put in a mattress of wire wherever the aneurysm began to bulge out.

Another point of interest is in connection with the development of an electrolytic injury of the skin. One very interesting case, which ought to have gotten well because his aneurysm was absolutely due to trauma and there was no syphilitic history, was that of a young man in whom, during my absence from the room, the needle was pushed in too far by an inadvertence by one of my assistants and produced such a burn. A slough was produced, and after a few months a long tape-like clot came from the opening in the chest, and finally a great gush of blood followed the clot, causing death.

In my experience there is no occasion for local anesthesia. I know this opinion differs from that of Dr. Beardsley, as he has said that the last patient whom I wired told him he suffered a great deal of pain. I think all the pain he could possibly have suffered was that produced by making a nick in the skin with a tenotome. It was a hospital tenotome, but at the same time it could not have caused much pain. The introduction of the needle does not cause as much discomfort as the use of the tenotome, and the introduction of a local anesthetic may cause sloughing. The point at which the expansion is most marked should be noted and the wire introduced there. There is no use in putting the wire directly into the caliber of the vessel—only into the sac. I am so firmly convinced of the great value of the operation that while I recognize that it is not curative, I feel that it offers much to the patient. Dr. Musser and I had a most interesting case of this character, in which the man lived for a year and then died of another malady. Dr. Da Costa and I had another case which did not live so long, but it was impossible to control the man, who immediately after the operation kept walking about the ward.

Dr. J. Chalmers Da Costa: I have been impressed with the fact that valuable methods are so easily lost sight of. If anyone will look in the *International Encyclopedia of Surgery* he will find a discussion upon the distal ligation in these cases. Dr. Hare speaks of a patient living over three years. You will find noted the case of a patient who lived for over four years after

distal ligation. A patient such as this man is not a fit case for distal ligation, because the aneurysm is in the descending aorta. In aneurysm of the ascending aorta, which involves the innominate artery, I think distal ligation should be considered.

In one case of aneurysm apparently involving the aorta the man got so well that he returned to his work as blacksmith, but died from recurrence. In a case of fusiform aneurysm the patient was restored to apparent health, and it has been two and one-half years since the operation. I would, therefore, beg to add to Dr. Beardsley's list of the four things that may be done, that at least in some we ought to give consideration to distal ligation.

Dr. Beardsley, closing: One of the very great difficulties in estimating the value of any treatment for aneurysm arises through the uncertainty of our knowledge of the prognosis in this condition. This is true of all treatments, and is also true of those cases which receive no treatment whatever. There have been cases reported by competent observers in which aneurysm of the aorta had persisted for twenty years without having caused the patient's death. while other cases live but a few months after the pulsating mass is discovered, Then, too, we are reminded that occasionally an aneurysm is discovered at autopsy which must have healed years before the patient's death from other causes.

Dr. Hare has criticized us for the local use of cocaine in tissues known to be lacking in vitality. In answer to this we can only state that the use of a drug which renders the operation practically painless, even if this drug has at times been known to cause sloughing, is justified in our opinions. Dr. Hare has had a very large experience with these cases and his opinion is of the greatest value, but we fear that he minimizes the amount of pain caused by the incision over the aneurysmal sac. We have noticed that the patients operated upon without the use of cocaine are not inclined to pronounce the operation "painless." It appears to us that if freshly prepared solutions of cocaine are used there is comparatively little danger of the tissues sloughing, while the operation is practically painless.

OPERATIONS FOR BRAIN TUMORS [1]

By WILLIAM G. SPILLER, M.D.

In considering operation for brain tumor we should bear in mind that we are dealing with a lesion that must in course of time prove fatal, and usually within a short time. Tumors of the pituitary body frequently seem to be of slower development than are newgrowths in many other parts of the brain. Acromegaly is a condition of slow development and long duration, and while a tumor of the pituitary body is not found in every case of this disease, it not rarely seems to be the cause, and when present does not appear to hasten greatly the fatal termination. Frequently cessation of menstruation is the first sign of tumor in this region of the brain, and it may precede the other symptoms for many years. A tumor of the pituitary body may attain considerable size without causing many symptoms, and a bitemporal hemianopsia may be its only sign for a long time. The sella turcica is enlarged by pressure from the growth, and the hemianopsia may in this way become less by relief of pressure on the chiasm. This variation in the hemianopsia sometimes perplexes the clinician. The third ventricle is above the pituitary body, and a tumor may grow to large size in this ventricle before it produces many symptoms. For these reasons one may hesitate before attempting to remove a tumor from this region. The operation in whatever way it may be undertaken is very serious, and while a few successful cases are on record, we cannot forget the grave danger in surgical intervention. It is important to keep in mind that because of the relations referred to above,

[1] Read February 2, 1910.

grave symptoms of tumor of the pituitary body are likely to indicate a large growth, and that operation would be much more promising if bitemporal hemianopsia were the only sign. Bitemporal hemianopsia may be produced by meningitis, fracture of the base of the skull, or aneurysm, but is strongly suggestive of tumor when developing slowly and without a previous trauma of the head; especially is this true if to the bitemporal hemianopsia complete blindness of one eye be added, indicating complete loss of function of the fibers in one optic tract, or if primary optic atrophy instead of papilledema be present. In some instances, as in a case reported recently by Gowers, primary optic atrophy may be observed on the side on which the tumor is larger, and papilledema on the other side where the tumor is sufficiently far from the papilla to permit papilledema to develop. In this case skilfully diagnosticated by Gowers, operation was performed by so experienced a cerebral surgeon as Horsley, and yet it resulted fatally.

The statement that operation is more likely to be successful when the tumor is small hardly admits of dispute, but it is not always easy to make the diagnosis in the early stages, and frequently the patient is not seen by the neurologist at this period. Symptoms which to an experienced physician are very suggestive of tumor may be attributed to gastric or hepatic disorder, to nephritis of pregnancy, or some other cause; and tumor especially of the cerebellum, may cause a condition of the retina resembling albuminuric retinitis.

It may not always be remembered that sudden death is common in cases of tumor in any part of the brain, but chiefly when the tumor is in the posterior cranial fossa. There is less room here than in any other part of the cranium for a new growth, and increase of intracranial pressure, therefore, occurs more rapidly, and the respiration and cardiac action may suddenly become seriously impaired.

It is wise always to present the condition clearly to those who may be responsible for the patient, and often to explain the condition to the patient himself if he be intelligent. One will frequently find that an intelligent person will demand that the

chance of operation shall be given to him, even though he fully realize how serious a surgical intervention may be. He recognizes, on the one hand, that he has a cerebral lesion which must prove fatal, and that the end may come suddenly within a few days, a few weeks, or after a longer period; that while he lives he must suffer great impairment of function in important structures and probably great discomfort, especially in headache, nausea, and vomiting. On the other hand, he knows that surgery may give him a chance for his life or for temporary relief, and he gives no choice to the physician, but demands as his right that the chance be given to him. More than once the surgeon will be told by the patient that no effort to remove the tumor is to be slighted, and that death would be preferable to a continued existence in his deplorable state.

There is no denying that the mortality in operations for brain tumors is high, but it is not so high as the mortality of tumor cases without operation, which approaches 100 per cent. Surgical technique has been so greatly improved in recent years that operations for tumors have become almost a special branch of surgery. The success of surgical intervention will depend chiefly on the correctness of the diagnosis, on the position and size of the tumor, and on the skill and experience of the surgeon. The neurologist must strive to make his diagnosis at an earlier period in the development of the tumor, and should not wait until all the important signs of increased intracranial pressure have developed, and to these are added many sharply focalizing symptoms. In the early stage of tumor general signs of intracranial pressure may be entirely absent, and there may be no headache, no nausea or vomiting, no papilledema. A slowly developing focal symptom or focal group of symptoms may be sufficient for exploration, and this is especially true if the lesion be diagnosticated as being in an accessible portion of the brain. Convulsions confined to one limb, or both limbs on one side of the body, or also to the face on the same side, and occurring repeatedly, indicate irritation of the opposite motor region of the cortex; and while the source of this irritation is not always detectable, a cause must

be present. Such convulsions are not always produced by tumor, but frequently are so produced, and at least twice in the writer's experience were the only important sign of a tumor discovered at operation. The motor region is easily exposed and little damage is likely when an osteoplastic flap is made, provided the patient's general condition permits operation. The scar from this operation may almost disappear and may be detected only by careful search, even a short time after the operation. It is probably a wise procedure to expose the motor cortex when the convulsions are strictly Jacksonian in type and of frequent occurrence. Unquestionably a tumor will not always be found, but if we expect to operate early we must be prepared to take more chances than in a case easily diagnosticated by a first year medical student, and yet rashness is not justifiable. A paresthesia confined to the distribution of the fifth nerve, followed after several months by anesthesia in the distribution of this nerve and paralysis of the muscles of mastication on the same side, indicates a lesion paralyzing the fifth nerve. In the writer's experience this symptom-complex has been produced by basal syphilitic meningitis, but it is more likely to be caused by tumor. When the Wassermann reaction is negative and antisyphilitic treatment has failed, the diagnosis of a tumor in the region of the pons may be considered probable, but a negative Wassermann test does not necessarily exclude syphilis of the brain. It is not easy to determine at first whether the tumor is in the pons or growing from the dura over the petrous portion of the temporal bone. Glioma within the pons does not destroy all the area in which it develops, and trigeminal disturbance may be the most pronounced sign of glioma of the pons, but some weakness of the opposite limbs is likely to develop soon. Tumor growing in the region of the petrous portion of the temporal bone usually causes pain in the distribution of the trigeminal nerve from irritation of this nerve, but in one of the author's recent cases pain was absent. A tumor in the middle cranial fossa may implicate the bone, and in the writer's experience has extended into and partly filled the nasal cavities.

The greatest difference in symptoms may be occasioned by a tumor just above the tentorium and one just below this membrane. When below, the symptoms usually are very characteristic, and are such as cerebellar ataxia, unilateral nerve deafness with facial palsy on the same side, early papilledema, nystagmus, vertigo, severe headache, etc. A tumor growing above the tentorium, from the floor of the middle cranial fossa, may develop to a large size with few symptoms, if it does not implicate the trigeminal and abducent nerves. Here it forms a nest for itself in the basal part of the occipital lobe by atrophy of the overlying lobe, and as the optic radiations do not extend to the base of this lobe, hemianopsia may not be present. Papilledema and headache may be the first signs of a growth in this region, and when the patient comes under observation the former may have attained so great a degree as to mask a hemianopsia that had been present. The tumors at the base of the occipital lobe are very likely to escape detection when small.

The endothelioma is probably the most favorable tumor for operation. It does not infiltrate the brain, it grows from the dura and is well defined, and is less likely to recur than is almost any other form of tumor. It seems a strange perversity of nature that most of the tumors in the cerebral hemispheres, where tumor is most accessible, are gliomata; and that most of the basal tumors, and, therefore, in regions of greater danger, are endotheliomata. Mallory regards the tumors commonly considered as fibromata or fibrosarcomata, as endotheliomata. These tumors occasionally develop over the cerebral hemispheres, and the most successful surgical cases are those in which a growth of this character is found. Endothelioma may infiltrate the overlying bone, and the hemorrhage then from the bone is severe when the bone is cut. A distinction should be made between a slowly growing and a rapidly growing endothelioma.

In the later stages of tumor the pressure at the base of the brain may cause partial obstruction of the ventricular cavities and hydrocephalus. The symptoms then become so indistinct and indicative of a widespread lesion that a focal diagnosis may

be impossible. The tumor often is so large at a late stage when operation is attempted that it cannot be removed, or if removed the patient dies within a few hours after the operation, if not on the operating table. The pathologist too often finds a tumor that should have been removed and had remained undiagnosticated, and, on the other hand, the surgeon sometimes removes an enormous tumor which from its character and situation should have given a favorable prognosis if permission for operation had been granted earlier.

It is not easy to explain certain signs of brain tumor. Failure of light reflex and bilateral exophthalmos have occurred in the writer's experience in tumor of the temporal lobe. Again, we may see improvement in the condition of a patient who has a large tumor of the brain, especially if iodide has been given. Why this occurs we do not know. The tumor has not diminished in size—indeed, it may have increased in size—and yet intelligence may take the place of stupor, and hopes are raised that soon perish. Seldom do periodic exacerbations occur in such an extraordinary manner as in the recent case reported by Rudolf and Mackenzie in which they seemed to be related to the menstrual period.

DISCUSSION

Dr. Charles K. Mills: My own experience with brain tumors extends into hundreds of cases I am sure, and with operative cases into the scores. About twenty-five years ago I had opportunity with Dr. Keen and others of seeing successful operations. I became convinced then and in the years that have gone by, for reasons that have been accumulating, of the value and imperative demand for operation in the majority of cases of brain tumor. It is true that as regards complete cure the results of operation are not favorable. However, as years have gone on we have had even a few cures, and we have had so many cases of relief and of prolongation of life that we must all accede to the value of operative interference. As with the treatment of aneurysm by wiring, which has been referred to this evening, pain is relieved, so with brain tumor similar and other relief, as of papilledema, is brought about by the surgeon acting in conjunction with the neurologist.

One thing that appeals to me is the fact that instead of the diagnosis being difficult in a comparatively early period, it is more certain as to exact location and the probable place of origin of the tumor. One of the things that most obscures the diagnosis of the position and full extent of the tumor is the confusion caused by late symptoms. These often seriously interfere with the neurologist making a diagnosis which will enable him to guide the surgeon as to just how far and just where he should operate.

Dr. Spiller has spoken of the jamming of the brain into the foramen magnum produced by a cerebellopontile tumor. Tumors in other regions of the brain, if large and dense enough, will do the same thing.

Last night in New York, at the meeting of the New York Neurological Society, I was much interested in hearing a paper upon tumors of the acoustic nerve. I have come to the conclusion that bilateral operation or unilateral operation, in which the unilateral opening is carried over the mesial line, is the most favorable method in cerebellar tumor.

I have seen at autopsy several cases of tumor of the spinal cord such as Dr. Spiller has mentioned. Years ago I saw such a case and greatly regretted that I had not had it operated upon. I saw in Pittsburg recently a case of tumor of the cervical spinal membranes, in which the symptoms were exceedingly serious. A tumor in the lower cervical region was found and removed.

Dr. Chas. H. Frazier: I have been very much interested in the specimens which Dr. Spiller has exhibited, and was surprised to see in how many the tumor seemed to be of inoperable variety. A considerable number of these which he has shown us tonight were sharply defined, frontal encapsulated tumors, and which, had they been accurately localized and were reasonably accessible, could easily have been removed.

My experience at the operating table does not correspond with what appears to be Dr. Spiller's experience at the autopsy table. By this I mean that in the great majority of instances the tumors exposed have been of the infiltrating unencapsulated type, a variety in which the question of removal need scarcely be considered. In fact, in all the cases we have operated upon during the past years at the University Hospital I can recall but two, speaking now of pretentorial lesions, endotheliomata of the type so graphically illustrated.

A great deal of time and much ink has been wasted in discussing the technique of cranial surgery. It makes little difference what method is used in uncovering the brain lesion, provided this stage of the operation is carried out dextrously, without much loss of time and blood. The most important phase of the whole subject is so frequently overlooked—namely, the ability to recognize the lesion and the experience of knowing how to deal with them. Just how much one is justified in continuing the search for the tumor, when not situated upon a cortex, is another matter of considerable importance, and we could dwell at length upon many matters such as these which ordinarily are supposed to have little to do with what is popularly known as cranial technique.

ACTINOMYCOSIS (STREPTOTHRICOSIS) IN MAN WITH THE REPORT OF A CASE OF PULMONARY INVOLVEMENT[1]

By ALFRED C. WOOD, M.D., and AUGUSTUS A. ESHNER, M.D.

The number of contributions that have appeared on the subject of actinomycosis is so large that no effort has been made to review all the literature in this article. Actinomycosis of the jaw in cattle was described by Leblanc, in 1826, under the title of "Osteosarcoma." In 1845 Langenbeck observed the "yellow granules" characteristic of some forms of actinomycosis in pus from a case of caries of the spine in the human subject. Lebert, in 1848, described similar granules in the pus from a thoracic abscess. The exhaustive contribution of Crookshank appeared in 1858. Rivolta, in 1868, noted the presence of the yellow granules in the swollen jaw of an ox. Hahn, in 1870, observed similar bodies in the hard, indurated tongue of cattle known as "wooden tongue." Bollinger showed, in 1876, that the disease affecting the jaw of cattle, and formerly called "osteosarcoma," was due to a fungus that Hartz, the botanist, named the "ray fungus," or actinomyces, on account of its shape. In 1878 Israel described the affection as observed in man, and in 1879 Ponfick established the identity of the disease in man with that observed in cattle. In 1885 Bostrom expressed the view that the ray fungus was a bacterium belonging to the genus cladothrix. Since this time the classification of the organism has been the subject of numerous contributions, but authorities still differ widely as to its proper grouping.

[1] Read March 2, 1910.

Two generic names have been applied to the microörganism causing this disease—actinomyces and streptothrix. The committee appointed by the Pathological Society of London, in 1899, recommended the adoption of the latter term, which has been accepted, among others, by Warthin and Olney, who believe it best to classify all streptothrix infections under the general heading of streptothricosis, giving in each instance the specific name of the particular organism causing the infection. Other authors hold, with Stokes, that the generic name for this group of germs should be actinomyces, as the other names suggested have been previously applied to other organisms. Until some agreement is reached, the only solution of this question would appear to be the employment of both terms, or to use them synonymously.

Morphology. It appears to be established that there are a number of varieties of the ray fungus—Wright tells us there are as many as twenty-five. Stokes says the various forms of pathogenic actinomyces can be classified at present as seven species, which produce suppuration or necrotic pseudotubercles in man and various animals. At the present time the different varieties can be recognized only from their cultural and staining peculiarities.

Microscopically, the fungus consists of the following parts: clubs, mycelium threads, and numerous small bodies like micrococci. Clubs may be absent, but the other two forms are always present. The threads are the spore form; the clubs are the mature germs. As Butterfield points out, too much importance has been attached to the presence of clubs. These are extremely variable in appearance, and their absence must not be considered as excluding the possibility of actinomycosis. Branched forms even are not always present, as, in old abscesses, the parasite may have undergone complete segmentation, and thus would be difficult to distinguish from bacilli. Careful search, however, will probably reveal short branches and a few long filaments.

Schabad considers as a subgroup the forms that do not show clubbed ends, and calls them "actinomyces atypica." These are acid-fast, and do not appear as "sulphur-like granules" in the pus.

In view of the fact that the ray fungus resembles the tubercle bacillus in certain particulars, especially in that the lesions caused by the two organisms have definite features in common, the view held by Metchnikoff, and revived by Wright, is significant. In 1888 Metchnikoff called attention to the variations in the morphology of the tubercle bacillus, which, he believed, was not the final stage, but represented a condition in the developing cycle of a thread-like bacterium, and pointed out that there is a progressive series of organisms from the harmless butter bacillus, through the turtle and fish bacilli, to the bovine and human bacilli. Actinomyces is essentially aërobic, and it has been shown recently that the tubercle bacillus growing on a favorable medium shows more frequently the branched forms when the access of oxygen has been free.

The ray fungus is said to occur on certain grains and grasses, particularly on rye. It does not appear to have been observed growing on plants externally, but if infected grain is planted, the fungus develops with the growth of the plant, so that the latter is infected throughout.

In addition to its occurrence in certain plants and in man, actinomycosis has been found in cattle, horses, pigs, sheep, and the elephant, but no example has heen reported in the carnivora, except one possible case, in which a pet dog died from a large swelling of the lower jaw; and subsequently, the owner of the dog, a woman, developed actinomycosis of the lower jaw. While the relation between the two in this instance may be suspected, it was not definitely established.

Mode of Entrance. In cattle, the disease affects the jaws or tongue in a large majority of instances, and in man the primary seat of the disease is in or about the mouth in over 50 per cent. of the cases. It is probable that infection takes place through the mouth in many additional cases in which the portal of entry cannot be established. It may be concluded, therefore, that the organism usually gains access to the body with the food or other articles taken into the mouth. In man, infection probably takes place frequently from chewing grain or pieces of straw or grass. It is

stated that 75 per cent. of the cases occur in those who have to do with these articles, *e. g.*, farm laborers, grooms, etc.

As to other modes of infection, Müller reports the case of a woman who developed a swelling of the hand at the site where a splinter had penetrated two years before. The swelling proved to be a focus of actinomycosis, and in the centre of the mass a minute fragment of wood was found. In another case the disease appeared at the site of a blow from a stick of wood. Von Partsch records a case in which the disease developed in the scar left by a surgical operation; and Kopfstein observed a case in which the disease appeared at the site of a cut on the hand of a woman who had been binding corn before the wound healed. Many cases have occurred at harvest time after threshing, as Illich has shown. Israel, however, disputes the view of infection through the skin, and thinks that in most cases infection takes place through the alimentary canal, as happened, for example, in a case of Soltmann's, in which an infected head of barley stuck in the esophagus of a child and caused infection of the lungs secondarily.

As regards the modes of infection of the lung, Hichens believes the fungus may be conveyed by the blood stream, be air-borne, or be spread directly from neighboring viscera. In the miliary variety of the disease the mode of infection is, of course, hemic. In the pleuropulmonary variety the invasion may be by direct extension from neighboring viscera, as in a case in which the disease apparently started in the liver and spread through the diaphragm to the base of the right lung.

Etiology. In reporting three cases in one family, Knox emphasizes the fact that all three patients had been in the habit of spending a good many weeks in the country—a farm in Perthshire had been visited for several years in succession. During their last visit the farmer was seriously ill with a slow form of consumption, from which he ultimately died. Cattle in the district had died from anthrax or some similar malady. The first patient developed serious symptoms at the farm; she had an attack of pleurisy, with high temperature, though it must be noted that her early symptoms were observed in London, and she was sent to Scotland to recruit

and, if possible, to avert a breakdown in health. She had visited the farm the year before and appeared to be in her usual health. The two boys had adenoids for years, and it is quite likely that the girl may have had them also earlier in life. The girl had glandular trouble, with abscesses, early in life; the second boy also had some glandular trouble; and the older boy had a definite glandular abscess. All had suffered from colds in the head and congested throats at different periods.

Wagner speaks of a case occurring in a farmer who was in the habit of chewing corn as he walked through the fields. McArthur relates a most interesting case in a young woman who frequently played golf, and while playing plucked and chewed hay. An obstinate abscess of the alveolar process first developed, and healed only after three or four months' treatment. Nine or ten months later a tumor developed in the right iliac fossa. At operation the cecum, being infiltrated, was resected. The disease was found to be actinomycosis. The patient recovered and was well for a period of three months. Then cough, fever, chills, and sweats appeared. These were at first thought to be due to pulmonary tuberculosis, but abscesses of the chest wall developed later, and in the contents of these actinomyces were found. The patient died.

Ingal's case occurred in a man, aged twenty-two years, who worked on a farm in Italy, and on the railroad in America, during which time he slept on a straw bed on a construction train. Hichen's case occurred in a farmer, aged thirty-two years. In Reignier's case, it is stated that the only possible source of infection was the straws used in drinking iced beverages. A number of cases are reported in which it is stated that the teeth were bad. Wright says: "Many cases seem connected directly with carious teeth." Some patients were the subjects of "winter cough."

Almost every part of the body has been affected—mouth, cheeks, abdominal viscera, appendix, lungs, pleura, and brain. The disease may be disseminated by the blood stream, and cases of generalized actinomycosis have been reported in both cattle and man.

The *Centralblatt für Bakteriologie* contains reports of 117 cases from 1887 to 1904, and in these the lesions were distributed as

follows: Neck, jaws, mouth, pharynx, in 72; primary in abdomen or viscera, in 18; thorax walls, lung, pleura, in 21; brain, in 3; skin, in 3.

In 1905 Hichens collected 79 cases, reported in the British Isles, and he found the disease distributed as follows: Head and neck, 27, or 34.17 per cent. (face and neck, 24; tongue, 2; brain and orbit, 1); thorax and lungs, 12, or 15.18 per cent.; abdomen, 39, or 49.3 per cent. (liver, 20; intestinal tract, peritoneum, and abdominal wall, 16; bladder and prostate, 2; generative organs, 1); site not stated, 1. Ruhräh, in 1899, collected all the cases at that time reported throughout the world, and presented the following table: Total, probably counting several twice, 1094; head and neck, 604 (56 per cent.); digestive tract, 233 (20 per cent.); pulmonary, 164 (15 per cent.); skin, 26 (20 per cent.); doubtful, 63 (6 per cent.).

Infectiousness. It is not believed that the disease is communicated from one person to another, or from animals to man, as a rule; but in a discussion before the Chicago Surgical Society, Dr. Carl Wagner related that one of the pupils of Professor Sacchi, Surgeon-in-Chief of the Doges' Hospital, Genoa, Italy, having opened an actinomycotic abscess, touched his nose before he had disinfected his hands. His nose became infected, and he succumbed very shortly to fulminant actinomycosis.

The pus in actinomycotic abscess is usually of limited quantity and has some of the characters mentioned as present in the sputum in pulmonary cases. In Knox's case it is described as "thick, tenacious, yellowish green in color, and very offensive in odor."

Pathology. The presence of the ray fungus in the tissues causes proliferation of round cells about the focus, resulting in a nodule. The central cells undergo granular or fatty degeneration, and more or less liquefaction results, while the cells toward the periphery of the nodule partially organize. The process is similar to that observed in tuberculous and tertiary syphilitic lesions, except that in actinomycosis the tendency to the formation of extensive granulation-tissue masses is greater. If the virulence of the infection is extreme, and especially if pyogenic infection is superadded, there will be more liquefaction and pus formation,

and less partly organized tissue. On the other hand, an uncomplicated infection of feeble virulence in tissues having a high degree of resistance will be followed by but little destruction, while a comparatively large amount of granulomatous tissue will result, which may form tumors of considerable size. Thus, two types may be recognized—the inflammatory and the neoplastic. The former is the more commonly observed in man, and the latter in cattle. The neoplastic type is much more amenable to treatment. Actinomycosis spreads by direct continuity irrespective of anatomical structure (and by the blood).

The prominent pathological characteristics of the affection are briefly: (1) A tendency to great cell proliferation, with little suppuration. (2) A disposition to spread toward the surface and to gain entrance into the blood current. (3) The presence of yellow granules (Bell).

Bell and others have found the ray fungus on microscopic examination in cases in which no granules were present; and Bevan records a case in which the pus contained small bodies similar to those observed in actinomycosis, although on microscopic study the tumor was found to be epithelioma, and the supposed granules were found to be "pearly bodies."

Treatment. The therapeutic problem may be stated as follows: A local infection due to the ray fungus is to be combated. The germ causes a localized granuloma somewhat similar to that due to inoculation with the virus of tuberculosis or syphilis, and, like these, the affection tends to spread locally as well as to involve distant parts. Under such circumstances, the proper course to pursue is clear.

Complete removal of the infected area by the knife or curette would be ideal. Unfortunately, this is impossible in most cases, as important or vital structures would have to be sacrificed. Whenever feasible, however, this radical procedure should be adopted. In all other cases in which the lesions are accessible to surgical attack, the infected area should be freely incised, diseased tissue removed by the curette as far as possible, and free drainage secured.

In 1885 Thomassen reported that potassium iodide had a curative influence on actinomycosis. This observation appears to have been confirmed by the experience of many surgeons. Unquestionably, however, it has entirely failed to exert the slightest effect in a number of cases, so that it cannot, in any sense, be looked upon as a specific. Bell's statement appears to be correct. He says: "The value of the iodide varies. In some cases it seemed to give marvellous results; in others it appeared to have no effect."

Bevan believes that the most effective treatment when the lesion is not accessible to surgical measures is a combination of potassium iodide internally, and the *x*-rays locally. The explanation is offered that the *x*-rays set free nascent iodine in greater amount than would otherwise occur. Ochsner calls attention to the necessity of administering large doses of potassium iodide, and speaks of giving as much as a dram three times a day before improvement began. He also points to the fact that veterinarians interrupt the administration of the iodide for about a week in order to give the spores an opportunity to develop, as they seem to resist the treatment. He cites an instance in which he ordered 90 grains three times a day for four days, then intermitted for three weeks; then repeated the dose. An obstinate case of actinomycosis of the face was thus cured after 30 grains three times a day had been given for a month without any effect. Ochsner believes that so long as abscesses are not present, patients invariably recover. Baracz states that he brought about recovery in nine consecutive cases by injecting 20 per cent. solution of silver nitrate into the tissues around the lesion. The injections cause the formation of a connective-tissue wall around the disease, which is thus circumscribed and held in check, and he believes the silver kills the germs.

Pulmonary Actinomycosis. In many of the reported cases the infection appears to have taken place through the mouth. The majority of patients suffered from adenoids, decayed teeth, pyorrhea alveolaris, catarrhal lesions, etc. It is quite probable that these conditions favor the lodgement and development of the germ, whereas a healthy mucous membrane might resist its invasion and the disease thus be averted.

Hichens divides pulmonary actinomycosis into four varieties: (1) Bronchitic, (2) bronchopulmonary, (3) pleuropulmonary, (4) miliary or hemic. Karowski recognizes but two forms: (*a*) Catarrhal, in which the germ becomes established on the surface of the bronchial mucous membrane, resulting in a chronic catarrh of the bronchi, with actinomyces in the sputum; and (*b*) destructive, which passes through three stages: (1) The germs penetrate the deeper layers of the bronchial walls, producing a destructive peribronchitis. The symptoms of this stage are indefinite; the condition may be mistaken for a beginning tuberculosis, but the absence of tubercle bacilli and the presence of actinomyces in the sputum will establish the diagnosis. In addition, the lesion is likely to be below the clavicle, whereas in tuberculosis it is usually apical. (2) The fungus has reached the pleura, causing a hemorrhagic exudation, which is attended with the usual physical signs of fluid in the pleural cavity. If not relieved by operation, the accumulation may discharge spontaneously, either through the skin or the diaphragm. (3) Metastatic deposits form in different parts of the body. In this stage the patient presents symptoms of general septicemia, and rapidly succumbs to the increasing toxemia.

There appear to be no typical symptoms. In many cases there is a history of a period of depressed vitality, during which the patient was lethargic and easily fatigued. Anemia and emaciation sometimes follow. The temperature remains normal or is but slightly elevated in most cases, but mild febrile attacks occur in some instances. The pulse is persistently increased in frequency, but less so than in tuberculosis. The febrile attacks were sometimes followed by the development of "congested throat;" and later by bronchial catarrh and expectoration. In some cases the sputum has had an offensive or characteristic odor. The discovery of the mycelium in the sputum is essential in making a diagnosis.

In many cases the sputum seems to have been somewhat characteristic. In Wynn's case it "was abundant and had a feculent odor." In Hichen's case "it was thick, tenacious, not nummulated, and of a peculiar color, resembling pale anchovy sauce. On being spread on a plate or glass, minute whitish-yellow bodies,

about as large as half a pin's head, were observed." Bevan has observed that it "has a distinctive odor, suggesting that of freshly turned earth." As reported in Henry's case, it was "abundant, very thick, viscous, extremely offensive, yellowish-green in color, and contained numerous yellowish granules of about the size of a pin's head." A specimen was sent to Dr. J. F. Hodgson, who reported: "The sputum is characteristic of actinomycosis of the lungs. The granules contain the fungus of actinomycosis. Filamentous forms are present, club-shaped bodies being absent. The filaments stain well with Gram's method. Numerous pus cells and pyogenic cocci are present."

There are no pathognomonic symptoms upon which a diagnosis may be made. In the catarrhal form the symptoms will be those of bronchitis, such as might occur in the early stages of tuberculosis. A careful examination of the expectoration should clear up the case. The same comment applies to the pulmonary and pleural forms. The presence of the ray fungus in the lesion must be demonstrated to justify a diagnosis of actinomycosis.

Actinomycosis often evinces itself as a chronic empyema. A diagnostic point in favor of actinomycosis is that when one opens what appears to be an empyema necessitatis, expecting to find a large cavity and quantities of pus, one finds no proper cavity at all, and only a small quantity of pus that oozes from a spongy tissue.

As regards the situation of the lesion, it is much more often basal than apical. Israel went to far as to say that it always began at the base, but Hichens shows that this is not the case. Illich found that of fifty-eight cases of pulmonary actinomycosis, the disease had begun in the upper lobe in nine instances. It must also be remembered that pulmonary tuberculosis may begin at the base. Nevertheless, a basal situation is a distinct point in favor of actinomycosis. Excavation and hemoptysis are rare in pulmonary actinomycosis.

Pain, even of a severe character, is common in actinomycosis when the disease has spread to the pleura and neighboring tissues. Pleuritic pains are, of course, not uncommon in tuberculosis, but in the latter they do not exhibit the same persistency and severity.

The temperature in actinomycosis is more irregular and generally less elevated, and does not exhibit in so marked a degree the hectic type so common in tuberculosis.

The tuberculin reaction has been observed by Illich and Friedrich in cases of actinomycosis as well as in those of tuberculosis. As a minor point, it may be observed that the lymph nodes are but rarely involved in actinomycosis. Furthermore, it must be remembered that pulmonary actinomycosis and pulmonary tuberculosis may coexist in the same patient. Two such cases have been recorded by Littledale and Eichhorst (Hichens).

Adami suggests that when actinomycosis is suspected, some of the discharge from the affected tissue should be collected and cleared by weak caustic potash, and smears made from the deposit. In this way it is possible to find the scattered threads.

Pulmonary actinomycosis is usually fatal. Illich was inclined to believe that death occurred in every case. Naussac places the mortality of the pleuropulmonary form at 75 per cent., and of the bronchopulmonary form at 72 per cent. As Bevan has shown, it is not safe to consider a patient cured because the lesion appears to have healed, as relapses are not uncommon after apparent recovery. Karowski states that cases of pulmonary actinomycosis in which operation has been performed successfully are extremely rare, but they would certainly be more frequent if an early diagnosis were possible.

Wynn found the average duration of the disease about ten months. In a few cases cure has been reported, but such a result cannot be expected with any confidence, as the affection appears to be only a little less fatal than streptothricosis of the brain or liver, from which, according to Acland, no case of recovery has been recorded. The case reported by Wynn is especially interesting, as it adds one more to the number of infections that apparently have been successfully treated with a specific vaccine prepared from the infecting organism.

In the pulmonary cases the lesion is, as a rule, not accessible to surgical intervention until the later stages, when the disease has spread widely in all directions, or has even been carried to distant

parts. Therefore, if actinomycosis of the lung is detected early, as it usually can be by careful microscopic examination of the expectoration, the administration of potassium iodide, in addition to appropriate hygienic measures, would appear to be indicated. By the time the pleural deposits have occurred, and abscesses of the chest wall have appeared, the disease has reached an incurable stage.

Knox reports the case of a boy, aged fifteen years, in whom the mycelium was found in the sputum, and who gained 28 pounds in weight from December 6 to the following April, and after the removal of adenoids, and the continued internal administration of potassium iodide. There was a corresponding improvement in the general condition and in spirits. A second case in the same family seemed equally benefited by a similar course of treatment.

Oil of eucalyptus has been employed by some surgeons, and Ruhräh cites a case reported by Butler, in which cure appeared to be effected by eucalyptus oil in spray and in capsules. This treatment has been employed also in conjunction with the internal use of potassium iodide.

As v. Baracz's method of administration of silver nitrate by hypodermic injection is inapplicable to cases involving the lung, he recommended intravenous injections of colloidal silver, as advised by Credé in the pulmonary form of the disease.

The most striking recent contribution on the treatment of pulmonary actinomycosis is the report by Wynn of a case involving lung and liver, successfully treated by a vaccine prepared as follows: Agar cultures of actinomycosis less than forty-eight hours old were taken, and the growth scraped off, sterilized, and dried for one hour at 60° C. They were then ground in an agate mortar with normal saline solution containing 10 per cent. of glycerin. The vaccine was standardized by weight, 1 c.c. of the emulsion containing 1 mg. of "actinomycotin." This was diluted 1000 times, and the dose used for inoculation was 0.001 mg. of the solid substance.

The case thus treated was that of a boy, aged fourteen years, admitted to the General Hospital, Birmingham, under the care of

Professor Saundby, on account of troublesome cough, abundant, offensive expectoration, and pain and swelling of the left side of the chest. The lower half of the left chest, anteriorly and laterally, below the fourth interspace was absolutely dull on percussion. Breath sounds and vocal resonance and fremitus were absent over this area. Posteriorly, resonance was impaired and moist rales were heard. Just below and outside the left nipple there was a rounded swelling, the most prominent part corresponding with the sixth interspace. The swelling was red, tender, and fluctuating. A diagnosis of empyema pointing through the chest wall was made.

Under chloroform anesthesia the swelling was incised and about 8 ounces of most offensive pus obtained. An inch of the seventh rib was removed. There was thus opened a ragged cavity extending upward toward the axilla, and apparently in the lung. The pus contained large numbers of small granules, which proved to be actinomyces. No other germs were present in the pus. The sputum contained the actinomyces, in addition to cocci and bacilli, but no tubercle bacilli were present. After the operation, on December 19, considerable discharge of pus took place through the drainage tube. This gradually lost its fetid odor. The sputum remained abundant, frothy, and offensive. Coarse rales were heard all over both lungs. The temperature for the first week was irregular, with evening rise to 99° and 99.5°; the pulse rate was between 100 and 120, and the respirations, which were between 32 and 36 on December 20, fell to between 20 and 24 by the end of the week. On December 28 the patient was transferred to the Jaffray Suburban Hospital.

The temperature from December 28 to January 8, the date of the first inoculation, was pyrexial, showing evening rises to 100°, and once to 102.3°. With the rise in temperature the rate of respiration increased to between 28 and 34, the pulse remaining between 100 and 120. The patient now looked and felt extremely ill, the cough was troublesome, and there was an abundant discharge from the drainage tube; the sputum was also considerable in amount. The day following removal to the Jaffray Hospital he complained of pain in the region of the liver, and this

organ was found to extend downward to within 1 inch of the umbilicus, and to be tender on pressure; the spleen also could be felt. It seemed probable that the operation had resulted in autoinoculation, with extension of the infection to the liver. The organisms in the pus and sputum were still active, and grew readily on culture media.

On January 3 the opsonic index was estimated at 0.3, and on January 7 at 0.5. On January 8 the first inoculation of 0.001 mg. of "actinomycotin" was given. Twenty-four hours later the negative phase was apparently over, as the index had risen to 0.7, and by January 16 it was 1.2. The patient had a good night after the inoculation, and in a few days the cough became less troublesome, and the sputum and discharge of pus diminished in a remarkable degree. The temperature dropped to normal the day following the inoculation, and remained normal for three days. On January 12 the discharge had so diminished that the drainage tube was removed; a slight irregularity of temperature occurred for a day or two.

On January 18 a second inoculation of 0.001 mg. was given, and on January 21 the temperature fell to normal, and afterward remained so. The respirations had decreased to between 22 and 24, and the pulse rate to between 96 and 108. The patient was allowed to get up for a short time on January 19. Inoculations of 0.001 mg. were given on February 11 and 25, and March 11 and 27—six inoculations altogether being given.

The opsonic index was estimated at intervals, the highest point reached being 1.7. A negative phase was never observed to last more than twenty-four hours, and the positive phase reached its maximum between the eighth and tenth days. Generally the temperature taken a few hours after inoculation showed a slight fall, but on one occasion there was a rise to 99.2°.

Wynn was not disposed to attach too much importance to the actual figures given for the opsonic index, as the difficulties in the way of making a satisfactory emulsion were great; but the difference between the films made from preparations with his own serum and those made from preparations with the patient's serum

was marked before inoculation was begun. Afterward there was no doubt that the patient's serum had a much higher opsonic power than Wynn's, and with practice the difficulties of technique were largely overcome and a fairly accurate count made. The improvement in the patient's condition after inoculation was most marked. There was no sputum a week after the first inoculation, the cough had disappeared by January 22, and the sinus closed rapidly, the discharge by the first week in February being exceedingly little. Attempts were made on several occasions to grow the organism from the pus, but these were unsuccessful after the second inoculation. There was a steady increase in weight from 4 stone 8 pounds (64 pounds), on December 29, to 5 stone 8 pounds (78 pounds) on February 4, and on leaving the hospital on March 27 the weight was 6 stone (84 pounds), a gain of 1 stone 6 pounds (20 pounds) in three months. The moist sounds in the lungs had disappeared and examination on the day before leaving the hospital showed some flattening of the left side of the chest in the lower axillary region, slight dulness on percussion, and a large area below the angle of the left scapula over which cavernous breathing was heard. This cavity was quite dry and no moist sounds were heard over it or elsewhere. The liver had slowly decreased in size until it could not be felt below the ribs. It was evident that the condition had left behind thickened pleura with a large cavity in the lung. There was no sputum, and only occasionally a dry cough. On April 26, 1907, the patient was shown to the members of the Pathological and Clinical Section of the Birmingham Branch of the British Medical Association. He then had not received an inoculation for a month and looked well and robust. No other treatment besides that described was given, except from January 11 to 18, when 10 grains of potassium iodide were administered three times a day.

The patient was seen subsequently at intervals of about a month as an out-patient. He continued well and had been free from pain or cough, except for a slight attack of bronchitis during the first fortnight in December, 1907. He was seen for the last time on February 20, 1908. There was then more flattening of the chest

at the left base; the cavity was smaller and no moist sounds could be heard; occasionally he had a dry cough, but there was no sputum, and the breath was not offensive. The liver and spleen could not be felt. His weight was then 6 stone 3 pounds (87 pounds). No inoculations of "actinomycotin" had been given since March 27, 1907.

It will be important in the future to determine whether a vaccine prepared from one of the easily grown species, or from a stock of laboratory culture, will have any effect upon an infection caused by another species of streptothrix. In this connection it is worth while recalling that temporary benefit was found in Ziegler's case of severe actinomycosis of the head and neck after injections of "bacterial protein" obtained from Staphylococcus aureus, and in Billroth's case after tuberculin injections.

As this is the only case treated by this method, so far reported, it is cited in some detail. Being a single observation, further confirmation is needed before a definite opinion can be given. It is to be hoped that additional proof will be speedily forthcoming.

Case.—J. R., male, aged thirty-six years, married, a worker in furs for twenty-three years, applied to the Polyclinic Hospital on July 28, 1906, in the service of Dr. Eshner, complaining of pain in the left side of the chest intermittently for five months, but worse and persistent in the preceding five weeks. There was also pain in the left shoulder. Breathing was painful and difficult, and there was dyspnea on exertion. The breath was fetid and the tongue heavily coated. There was no cough or expectoration. The appetite was lost and the bowels were constipated. Sleep was poor. The man was weak, although there had been little or no loss of weight. He was 5 feet 3 inches in height and weighed 123 pounds. There was no headache, no edema, no derangement of micturition. The urine was free from albumin and sugar.

The patient was born in Russia, but had lived in the United States for sixteen years. He related that his parents, as well as a brother, were living and well. Another brother had died insane and a sister had died in confinement. There was no family history of tuberculosis, malignant disease, heart disease, or kidney disease.

The man had had measles, mumps, and chickenpox in early life, but he denied venereal disease, and he had no knowledge of a previous attack of pleurisy or pneumonia. He did not drink tea or coffee, but was in the habit of taking a small glass of whisky before breakfast; he smoked but little. He had been married for sixteen years. Five children were living and well; twin children had died, one from measles and the other from diphtheria. His wife had had no miscarriages.

On physical examination the action of the heart was found to be rhythmic and the sounds were clear. The percussion note was impaired at the base of the left chest, the breath sounds were feeble, and vocal resonance was diminished. It was at first thought that this condition was the remains of a previous pleurisy. The distress in the left side of the chest persisted, and in a short time tenderness developed in the splenic region and was increased by the ingestion of food. Later, tenderness became localized over the seventh and eighth ribs on the left side of the chest in front. The man was steadily losing weight and became lacrymose and easily agitated. By September 18 he had become reduced to 117 pounds. Movable dulness was detected at the base of the left chest, in addition to other signs of the presence of fluid in the pleural cavity. The possibility of malignant disease of the pleura now presented itself, and the patient was admitted to the Polyclinic Hospital, where, on September 20, the chest was aspirated and 27 ounces of turbid, straw-colored fluid were removed. The area of abnormal dulness on percussion diminished, and the breath sounds became audible in the affected area. A trace of albumin and a few granular casts were now found in the urine.

A second aspiration was performed, on October 4, and 13½ ounces of thick, stringy, turbid, reddish fluid were removed. This was found to be slightly alkaline, loaded with albumin, free from sugar, containing a few mononuclear leukocytes and pneumococci, but no tubercle bacilli.

The symptoms grew progressively more aggravated, and sweating set in, while the physical signs underwent little change. On December 15, 6 or 8 ounces of fluid were removed from the chest by

aspiration, with little or no relief. Chills occurred and the finger nails became curved.

Dr. J. H. Musser saw the patient in consultation on January 11, 1907, and advised resection of a rib or aspiration. Accordingly, the patient was again admitted to the Polyclinic Hospital. Aspiration was attempted, but no fluid was obtained.

On January 29, Dr. L. W. Steinbach resected about 1¼ inches of the seventh rib in the midclavicular line. When the pleura was incised, a small amount of pus, perhaps 3 ounces, having an offensive odor, escaped. Exploration with the finger disclosed pleural adhesions, but the source of the pus could not be discovered. A culture was taken, but no report of the result was made. The patient improved somewhat and was discharged from the hospital on February 12.

Subsequently the man grew worse again, and he was admitted to the Hospital of the University of Pennsylvania, February 22, in the service of Professor J. William White. The following notes were taken on admission by Dr. E. L. Eliason, resident surgeon:

"The man complains of pain in the lower part of the chest on the left side, shortness of breath, fever, and loss of weight and strength. Temperature, 99.1°; pulse, 108; respiration, 28. He is emaciated, pale, phthisical-looking, emotional, and nervous. Pulse full and strong; breath offensive; tongue coated; teeth poor; eyes bright and restless; skin dry, pale, and pearly.

"Inspection of the chest shows a marked decrease in the respiratory excursion on the left side, especially below the fourth rib in the anterior axillary line. The interspaces are bulging below this level and there is slight edema of the surface.

"Percussion elicits a flat note over the entire left side of the chest below the lower border of the second rib in front; the fourth rib in the anterior axillary line; the seventh rib in the posterior axillary line, and just below the spine of the scapula posteriorly. The dull area is stationary on change of posture. No egophony or cracked-pot sound can be elicited. On palpation, tactile fremitus over the entire surface is greatly diminished. Whispering pectoriloquy is present posteriorly at the fifth rib. Auscultation

reveals absent or distant breath sounds and vocal fremitus over the dull area. Resistance is also markedly increased to the percussing finger. Above this area the percussion note is apparently normal, but many moist rales are heard.

"The right lung at the apex shows impaired resonance, broncho-vesicular breathing, increased vocal and tactile fremitus and moist rales. Posteriorly at the base near the spine, Grocco's sign of a triangular dull area seems to be present.

"The heart dulness is pushed up and merges into the other dull or flat area. The heart sounds are clear but somewhat distant; the apex beat is not palpable. No friction sounds or murmurs are heard. Rotch's sign and Ewart's second rib sign are absent.

"There is a wound of the left chest at about the sixth rib in the midclavicular line, the result of a recent operation. There is marked pain in the posterior axillary line at the base of the chest. The patient has a troublesome, paroxysmal cough. There is tenderness over the dull area anteriorly from the scar down to the costal border. The abdomen is apparently normal. The leukocytes number 12,640 in the cubic millimeter. The urine has a specific gravity of 1024, is acid in reaction, and contains no albumin, no sugar, and no casts, but some mucus."

It was supposed that the man's condition would be improved by better drainage; hence, the wound in the chest was enlarged and thoroughly explored on the 26th, but no pus was found. The aspirating needle was introduced at five or six different points, but without finding any pus.

The opinions of those who examined the patient were divided. The evidence pointed to the presence of empyema or of greatly thickened pleura. On March 2 the leukocyte count was 13,520. The wound was still discharging slightly.

On the 13th, further exploration seemed indicated, and a portion of the seventh rib was removed. Careful digital examination was made, but no pus was found. No cavity existed, but the finger could be passed in all directions through soft, friable tissue, that bled freely. The condition suggested a soft round-cell sarcoma or a proliferative pleurisy. The section of rib removed appeared

to be diseased.[1] After this exploration the upper wound discharged pus more freely.

On April 1 increased swelling and edema were noted in the midclavicular line about the eighth rib. This was incised and a small amount of pus escaped.

On the 11th a fulness had appeared in the posterior axillary line between the seventh and tenth ribs. There was no redness or heat of the skin. Beneath this area breath sounds, as well as the vocal and tactile fremitus, were diminished. The three wounds already made were discharging pus, but the physical signs did not improve.

Over the right chest, at the ninth rib posteriorly, and in the postaxillary line, there was a swelling that appeared as though something were pushing the entire chest wall out. There was dulness over this area and increased tactile and vocal fremitus and distant breath sounds were noted. The liver dulness was pushed down in front to the seventh rib, in the midclavicular line.

On May 1 the granules characteristic of the ray fungus were observed in the pus. Microscopic examination confirmed the presence of this organism.

The patient showed increasing emaciation; respiration was shallow and painful. The upper wound in the anterior axillary line was discharging a large amount of pus and the lower one rather less, but still a large amount. Considerable bleeding from the wounds followed the withdrawal of the packing; there was great tenderness and swelling of the sternum at the level of the second rib. An opening was made in this situation on May 5, and a great deal of thick, gelatinous pus, full of sulphur-like bodies, escaped. No organism was present except the ray fungus (Dr. Gildersleeve). The discharge from all the wounds contained the sulphur bodies in large numbers.

[1] Dr. George P. Müller kindly examined the portion of rib removed and reported as follows: Specimen, section of rib. Pathological diagnosis: osteomyelitis. Description of specimen: The specimen is a section of bone, apparently of rib. Upon one side an osteophyte, osteoma, or callous formation has taken place. Microscopic section shows an acute inflammatory process within the bone. The Haversian canals are dilated and many of them are filled with an inflammatory exudation consisting of polymorphonuclear leukocytes and blood. The bloodvessels are universally dilated.

Potassium iodide was now ordered in heavy doses, and iodine was used locally in the abscesses.

On the 15th it is noted that the area over the last three ribs, extending to the spine on the left side, posteriorly, which had been painful and tender for a month, showed fluctuation. On incision, a large quantity of fetid pus, of a brownish color, was discharged. Sulphur bodies were present in great numbers. The cough, which had been persistent, was now accompanied by bloody expectoration.

On the 20th another sinus opened spontaneously at the junction of the sixth costal cartilage with the sternum.

On the 22d it is noted that the sulphur bodies from all the wounds were less numerous. The cough had increased, the sputum was purulent, but did not contain blood; the swelling over the ribs on the right side had disappeared. The patient appeared to be improved for a few days, but he became weaker again.

On the 25th the iodide was stopped, as it was not well tolerated by the stomach, and subsequently soluble iodine was administered in sherry wine. It was well borne in doses of 20 minims three times daily. By June 12 the sulphur bodies were seldom observed in the pus from any of the wounds. The leukocytes numbered 13,800 in the cubic millimeter.

The patient grew progressively worse; weakness was extreme; chills occurred irregularly, followed by profuse sweats; the liver showed marked enlargement downward, extending three fingers' breadth below the ribs in the nipple line, and jaundice became marked. Death occurred June 20.

The foregoing case is a typical example of the pleuropulmonary form of actinomycosis. The points of special interest are: the slow and insidious onset, signs of pleural effusion with an unusual history and course, peculiar character of the aspirated fluid, especially that obtained at the second aspiration, increasing symptoms in spite of the withdrawal of the fluid, the small amount of pus obtained on resection of a rib in the presence of pronounced dulness and the failure of all further exploration to discover any collection, the presence within the chest of soft tissue through which the finger passed readily, the multiple lesions, appearing one

after another, the characteristic discharge containing the so-called sulphur granules, the slight degree of fever, progressive loss of strength—and death.

BIBLIOGRAPHY

Meier. Centralbl. f. Bakteriologie, 38, 257 (abst.), Western Med. Review, 1905, x, 241.
Wynn. Brit. Med. Jour., 1908, vol. i.
Reignier. Jour. de méd. de Paris, 1905, 2 s., vol. xvii.
Henry. Lancet, 1904, ii, 1449.
Butterfield. Jour. Infec. Dis., 1905, ii, 421.
Knox. Lancet, 1904, ii, 1204.
Hichens. Brit. Med. Jour., 1905, ii, 1168.
Editorial. Lancet, 1904, vol. ii.
Karowski. Lancet, 1898, i, 902 (Berlin Correspondence).
Bell; Adami; Chipman; Hamilton; Nichols; Archibald; Keenan; Abbott. Montreal Medical Journal, 1905, xxxiv, 81.
Ingals. Western Medical Review, 1905, x, 436.
Warthin and Olney. Amer. Jour. Med. Sci., October, 1904.
Wright. Amer. Jour. Med. Sci., 1904, cxxvii, 74.
Ruhräh. Annals of Surgery, October, November, December, 1899; February, 1900.
Bullitt. Annals of Surgery, May, 1900.
Bevan. Annals of Surgery, 1905, xli, 641, 792.
Stanton. Albany Med. Annals, 1905, xxvi, 738.
Lyon Médicale, 1905, civ, 1398, 1319, 869, 107.
Crawford. Lancet, 1905, ii, 157.
Taylor. Guy's Hospital Report, 1891, xlviii, 311.
Carr; Johnson; Power. Lancet, 1904, ii, 1216.
Sanfelice. Centralbl. f. Bakt., etc., xxxviii, 30.
Stokes. Amer. Jour. Med. Sci., 1904, cxxviii, 861.
v. Baracz. Annals of Surgery, 1903, xxxvii, 236.

DISCUSSION

Dr. George E. de Schweinitz: Among the unusual causes of disease of the lacrymal sac and nasal duct, actinomycosis of this region has been reported, especially by von Schroeder, and there are several cases on record. The condition is mentioned on account of the close association of the lacrymonasal structures with the upper respiratory passages.

THE CLINICAL VALUE OF SKIAGRAPHY IN DISEASES OF THE NASAL ACCESSORY SINUSES[1]

By CORNELIUS G. COAKLEY, M.D.

About five and one-half years ago, Dr. Caldwell took for me the first skiagraph of the nasal accessory sinuses made in this country. The inspiration came from seeing two plates made in Freiburg, Germany.

When I look at that first plate and compare it with those made today by expert radiographers, the contrast is truly wonderful.

The equipment, experience, and art required to produce a good plate of the sinuses, are such that some fail to secure a negative much better than Dr. Caldwell's first plate.

The production of the negative and its interpretation are two distinct processes.

From my experience with plates made by various men, I think it proper to say that satisfactory plates are seldom obtained except by those making a specialty of x-ray work, having the best possible equipment and the opportunity to take enough sinus cases to perfect themselves along that line.

The interpretation of a plate should be the combined work of the Röntgenologist and the clinician. The former, from his large experience in interpreting a great variety of plates, will be of great help to the clinician in calling attention to certain unusual features. The clinician, on the other hand, may be able, by the aid of the plate, in conjunction with the physical examination of the patient, to get more help than that which the plate alone shows.

[1] Read April 6, 1910.

The greater the number of plates examined by the clinician *in connection with his patients,* the greater the facility in interpreting them.

The knowledge acquired from operations on patients having had plates made is invaluable for the clinician, and in that respect he is storing up a fund of information that cannot be acquired by the Röntgenologist.

In the ensuing remarks upon the clinical value of skiagraphs, let it be understood that I know nothing about the technique of making skiagraphs. I also take it for granted that you are all fairly well acquainted with the past literature on the subject, and are convinced that a good anteroposterior skiagraph can be depended upon to outline the vertical height and width of the frontal sinuses, if they exist; in most cases determine the presence of an orbital recess; that the lateral view will give one the thickness of the anterior bony wall of the frontal sinus, the depth of the sinuses, from which, in conjunction with the height, one can judge the probable deformity as the result of external operative measures; that the ethmoid region can be accurately mapped out as to its height and width; that the antra can be plainly demonstrated; that the full size and shape of the sphenoidal body, and possibly even the approximate size of the sphenoidal sinuses, may be determined.

A patient is referred to a radiographer for a negative for one of two reasons:

1. As an aid to diagnosis.

2. In manifest suppurating disease of the sinuses, to help to determine the advisability of intranasal or external operative surgical treatment.

1. As an an aid to diagnosis:

Experience has taught me that plates may be divided into three classes, (*A*) good; (*B*) fair; (*C*) poor.

(*A*). *Good plates:* A radiograph may have such an intrinsic value as from it alone the situation of some unusual anatomical condition or pathological lesion may be certainly predicted. In other words, anyone familiar with radiograms of the head would make the diagnosis without ever seeing the patient, or knowing

the clinical history. The nature of the pathological lesion can seldom be predicted.

I am well aware that a very solid tumor, like an osteoma, or dense fibroma, casts a denser shadow than pus, and thickened and inflamed mucous membrane, but few would care to make a differential diagnosis on depth of shadow.

As between pus in a sinus, thick membrane in a sinus, or partly pus and partly thickened membrane, or the moderate involvement of the membrane by malignant disease, my clinical operative experience teaches me that one cannot differentiate between these from an inspection of the skiagraph.

The experimental work of Caldwell and Chisholm on the cadaver, tissues, and fluids confirms this view.

An excellent negative of intrinsic worth cannot always be obtained. In patients with large heads and very thick bones we seldom get a clear negative. Patients who have a general acute inflammation of all the sinuses usually give a negative that is nearly equally cloudy throughout all the sinuses, although the clinical evidence may demonstrate that the major part of the disease is in a limited group of the sinuses.

I have also noticed that in some acute cases the cloudiness of the sinuses in the skiagraph may persist a month or more after all clinical evidence of the disease, both subjective and objective, including transillumination, has disappeared.

There is a class of sinus disease that can only be diagnosticated previous to operating by means of the skiagraph. I refer to what is known as the closed type of empyema.

The patients either have no discharge from the sinuses into the nasal cavities, or a discharge in such small amounts and at such rare intervals that repeated investigations on the part of the rhinologist fails to detect any secretion.

Transillumination does not help in the diagnosis of these cases; in fact, it has a tendency to mislead. The sinuses are dark on transillumination, just as they are in patients who have no sinuses. One is apt, therefore, to think that the darkness is due to an absence of the sinus.

A skiagraph not only will demonstrate the fact that there is a sinus present, but a good negative will show whether it is extensively diseased or normal.

Can there be disease of the sinuses which is not revealed by a *good* skiagraph?

This question, which is of the greatest importance to the clinician, can be answered only in the light of our experience up to the present time.

For the frontal sinuses, I can say *no;* for the ethmoid, *yes;* for I had a case with extensive ocular disturbance, some pus in the posterior part of the nasal cavity, and yet both ethmoids were equally clear in the skiagraph.

An external operation found thick membrane and some mucopus in one cell, size of a large pea, probably a posterior ethmoid cell. The other ethmoid cells were normal.

The shadow cast by such a limited diseased area, so far from the plate, was not appreciable.

For the maxillary sinuses, probably *yes,* owing to the shadows cast by structures at the base of the cranium.

For the sphenoid, *yes,* for the same reason as given for the ethmoid.

(*B*) *A fair negative:* By a fair negative I mean one in which the outline of the sinuses may be distinctly seen, but the general cloudiness of the plate is such that it is impossible from the examination of the plate alone to tell whether all of the sinuses are diseased, none of the sinuses are diseased, or some of the sinuses are diseased and others normal.

It is this class of negatives that has caused the rhinologist having slight knowledge of the subject to belittle the value of skiagraphy.

This class of negatives is of little use when taken by itself, but, in connection with the history of the patient, the intranasal examination, probing the various sinuses, and in conjunction with transillumination, may be of considerable value to the experienced clinician, who may be able to derive from such a plate enough to complete his diagnosis.

The radiographer, if he were to attempt the reading of such a plate, would be very apt to draw unsound conclusions.

I believe, therefore, that the rhinologist, in order to be able to derive the full benefit from skiagraphy, should learn to interpret his own plates, and not rely solely upon the interpretation of the radiographer.

The radiographer's opinion should be given on all plates such as he feels are distinctive enough to warrant forming an opinion, but this opinion, unless exceedingly positive, should have the same weight with the rhinologist as the report of a urine analysis would have in reference to lesions of the kidneys.

Some urine analyses are sufficient in themselves not only to indicate disease, but the exact type of disease, while other analyses are of value only when taken in connection with the clinical history and physical examination of the patient.

(*C*) *Poor negatives:* These are of such little value to either the radiographer or the clinician that they call for another exposure.

2. In manifest suppurating disease of the sinuses, to help to determine the advisability of intranasal or external operative surgical treatment.

A discussion of this subject would lead us into rhinology and away from skiagraphy.

We may state, however, that in the event of determining upon an external operation, the surgeon may plan in advance the type of operation he is to perform, in accordance with the size, shape, and number of the diseased sinuses.

He will also be able to inform the patient in advance of the operation the character and amount of facial deformity that will be produced by the operation.

THE PATHOLOGY OF MASTOIDITIS AS REVEALED BY THE X-RAY[1]

By SIDNEY LANGE, M.D.
LECTURER ON RADIOLOGY, MEDICAL DEPARTMENT OF THE UNIVERSITY OF CINCINNATI.

The *x*-ray study of the mastoid region which was begun in March, 1908, has undergone a slow but gratifying metamorphosis. Undertaken with grave doubts as to its practical value, it has developed into a method which rivals in its accuracy other recognized methods of physical examination.

At the inception of the work, it promised at best to show up the anatomy and the grosser chronic changes in the mastoid region. Then the graver acute changes were registered on the skiagram, and later it was found that the milder acute mastoid affections yielded röntgenological evidence of their presence. Within the last few months it was discovered that in acute otitis media without clinical signs of mastoid involvement the *x*-ray plate would often show clouding and filling up of the mastoid cells just back of the antrum, which changes may either recede or progress as the case either recovers or goes on to what is clinically termed mastoiditis. The *x*-ray method is presented then as a method of studying *intra vitam* the gross pathology of the mastoid.

A correct röntgenological technique is of course the *sine qua non* in this work, and all conclusions should be based upon technically good plates. The method employed for correctly skiagraphing the mastoids was presented before the American Medical Association one year ago by Dr. S. Iglauer.[2] Further details of the *x*-ray

[1] Read April 6, 1910.
[2] Jour. Amer. Med. Assoc., September 25, 1909.

technique were outlined by me in a previous paper[1] and need not be repeated here. In no instance has a technically good plate failed to give valuable and accurate information. Barring those uncommon cases in which the cortex over the mastoid is excessively thick, or in which the mastoid cells are poorly developed, the *x*-ray method should in every case reveal in a gross way the pathological status of the mastoid process.

The question of excessive distortion of the relations of the mastoid as a result of the obliquity of the rays was answered by making a series of tests on the dried skull. Lead markers were placed upon the tegmen groove for lateral sinus, mastoid tip and measurements made from the skiagraph were compared with the actual distances. In no instance did the discrepancy exceed 3 mm., which difference, for practical purposes, may be disregarded.

Our interpretation of the skiagram is always based upon a comparison of the diseased with the opposite normal mastoid. After repeated comparisons, in normal individuals, in no case did we find essential differences between the two normal mastoids of the opposite sides. While there may be variations in the size, number, and arrangement of the cells of the two sides, the mastoids as a whole were closely similar in type; that is, if there is a pneumatic mastoid on one side there will be a pneumatic mastoid on the other, or if the one mastoid is of the diploetic type the opposite one will be of the same type. Plageman says: "Upon a basis of 85 skiagrams of normal skulls, we find, as a rule, the two mastoid processes of healthy individuals are almost identical." Where both sides are diseased more difficulty is encountered in reading the plates, but after a study of many plates a fairly accurate interpretation may be made of a single plate without a comparison with its fellow of the opposite side.

Previous inflammation in a mastoid usually leaves permanent alterations in the bone, either in the form of more or less extensive absorption of the mastoid process or sclerosis of same, and if this inflammation occurs in early life the development of the mastoid

[1] American Quarterly of Röntgenology, December, 1909, vol. ii. No. 1.

may be so retarded as to result in a diploetic or even sclerotic type. Therefore, in interpreting mastoid plates the previous aural history must be ascertained.

Upon the mastoid skiagrams of children under ten years the mastoid appears entirely spongy or diploetic, there are few visible cells, and the tip is undeveloped. The tip at this time consists simply of an inner and an outer table, with little cancellous bone between, and shows little structure upon the skiagram. From ten to fifteen years the mastoid takes on the pneumatic characteristics, large cells appear and grow downward toward the tip, its diploetic structure finally giving way to the more or less pneumatic adult type. The development of the mastoid may be beautifully demonstrated by a series of successive skiagrams.

In order to study the mastoid relations more graphically, stereoscopic skiagrams may be made. For this purpose I have devised a small stereoscopic platform, by means of which the two stereoscopic exposures may be made upon a 5 x 7 plate. When developed and dried this plate may be placed directly without printing or reduction in a cheap parlor stereoscope, and viewed by transmitted light. This method has not been used as a routine, because of the fact that four exposures (two for each mastoid) are required. A reluctance to make repeated exposures has interfered also in following the clinical cases at various stages from onset to cure. While the danger of the temporary Röntgen alopecia is a remote one, even though the exposures be repeated, providing an aluminum and leather filter be used, it was thought best not to take the chance of embarrassing the work at this time by any such untoward after effects. Therefore, in most of the cases to be shown, but one exposure of each side was made. Just one caution in regard to the character of tube best suited to this work. The lowest or softest tube possible should be employed. The higher tubes give crisper pictures, more beautiful to look at and better from a technical standpoint. But when we consider the small size of the mastoid cells and the fact that we are attempting to show all the smallest septa and contents of these cells, those tubes which give beautiful bone detail of the heavy cranial bones will often fail to show the slighter changes in density in the mastoid region.

The pathological changes which may be noted upon a skiagram may be tabulated as follows:

1. Slight haziness of cell spaces or complete filling of same with something denser than air. These changes represent clinically otitis media with slight mastoid involvement and the milder forms of mastoiditis. The *something* which fills the cells is in all probability serum. To show these slight changes the skiagram must be made with a soft tube and slightly underexposed.

2. Loss of distinctness of cell walls with partial destruction of same. Clinically these changes are found in the more severe grades of mastoiditis with pus formation, and bone softening.

3. Complete loss of structure of the mastoid process occurring (*a*) either in the form of localized abscess formation, or, (*b*) as is often seen in the subacute cases, in the form of extensive loss of structure, indicating advanced necrosis of the entire mastoid process.

4. Increased density of the mastoid process with (*a*) partial or complete obliteration of cells and (b) with bone defects. This class represents the chronic sclerosed cases.

These changes will be discussed in the reverse order, the order in which they were recognized.

Chronic Mastoiditis. The first report upon this work was based entirely upon the examination of the chronic cases. The ease with which chronic changes can be shown upon the skiagram offers us a method of determining in any case of chronic otorrhea the pathological condition of the mastoid process. In those cases in which the cause of the continued discharge cannot be determined by the usual methods, the skiagram may give the desired information by showing the extent of the sclerosis on the one hand, or gross bone defects on the other.

The skiagraphic appearance in these cases is a thickening and obliteration of cells. In older cases the entire mastoid process appears dense and structureless, giving no indication of the presence of cells. From our limited experience it would appear that this complete sclerosis occurs frequently after mastoiditis of a mild and not necessarily long-continued type, since the sclerosing process

is a healing process. Interesting to note is the fact that, in the examination of supposedly normal cases for purposes of study, every now and then a markedly sclerosed and often undersized mastoid process would be found, and no history of previous ear trouble be elicited from the patient. These undersized sclerotic types probably represent a sclerosis, partial absorption, or retardation of mastoid development, consequent upon a forgotten otitis media of early childhood. Aside from these occasional exceptions, all of the markedly sclerosed cases examined were causing symptoms in the form of intermittent otorrhea. To illustrate different phases, several cases will be cited briefly.

(*a*) *Sclerosis.* A. V., aged sixteen years, presented intermittent discharge from the left ear dating from an attack of acute otitis media three years back. Examination revealed a thickened drum with a small perforation in the antero-inferior quadrant. *X*-ray examination showed a sclerotic mastoid upon the left side, with very little evidence of cellular structure. Subsequent operation verified the *x*-ray findings. This history is typical of a majority of chronic cases encountered.

(*b*) *Sclerosis with Bone Defect.* J. Z., an Italian, was admitted to the Cincinnati Hospital because of some pain and tenderness over the mastoid. Previous history could not be obtained, except that the affected ear had discharged for some time. Examination of the canal revealed changes associated with chronic middle-ear suppuration. An *x*-ray examination of the mastoids showed upon the affected side no cells. Instead, the bone seemed to be hollowed out just back of the antrum. Upon operation, no cells were found, but a large bone defect in a small sclerotic mastoid.

(*c*) *Subacute Case with Bone Softening.* The next case is a subacute case rather than a chronic one, but is included here because the plate showed typical bone defects in a thickened mastoid and as might be encountered in the more chronic cases:

Mr. C., aged thirty-five years, came in from one of the surrounding towns because of continued discharge and pain over the mastoid dating back seven weeks. The case had received practically no treatment. Examination showed a perforation in the anterior

inferior quadrant. No bulging of the canal. Temperature, 99.5° in the evening, normal in morning. Pain was marked especially at tip. The patient was referred to me for *x*-ray examination, which revealed an apparently thickened and structureless mastoid except for several irregular areas of apparently more necrotic bone which seemed to honeycomb the mastoid. Operation the following day substantiated the diagnosis in every deatil.

Severe Acute Mastoiditis. Every case of *severe acute* mastoiditis has given distinct evidence upon the skiagram. The changes varied from filling of the mastoid cells with something other than air (serum, pus, or granulations) with indistinctness and partial disappearance of cell outlines, to circumscribed abscess formation or diffuse loss of structure of the mastoid.

Mrs. S. gave a history of a running ear following an attack of influenza. Discharge continued two weeks and then stopped. Two weeks later, or four weeks after the onset, the patient came under medical observation because of pain over the mastoid, especially right. Examination revealed a thickened drum, no discharge, no perforation, marked tenderness over mastoid, but no redness or swelling. Temperature, 99° to 100°. *X*-ray examination revealed a hazy mastoid, whose cells were no longer air-filled, and septa partially broken down. Operation the day following the *x*-ray examination verified the skiagram.

Miss B., aged twenty-five years, gave the following history: Had influenza three weeks previously, with a running ear, but without pain or tenderness over the mastoid. Discharge continued for three weeks, and patient finally sought medical attention because of an increasing malaise.

Examination revealed a large perforation in posterior part of the drum, with scant or no discharge. There was no swelling or redness over mastoid, but marked tenderness on deep pressure over antrum, no fever.

X-ray examination revealed a small abscess in the mastoid about the size of a hazelnut. The rest of the mastoid appeared hazy and indistinct. Subsequent operation verified this finding in every detail.

The following case is typical of a number of cases observed from the onset, in which there were definite signs of severe mastoid involvement, but in which the operative indications were not clear. Operative interference is often delayed in these cases awaiting a spontaneous resolution. The *x*-ray plate showing the amount of destruction may be a deciding factor.

Miss H., a nurse at the Cincinnati Hospital, aged thirty years, incident to influenza, developed intense pain in ear, which in a few hours was followed by rupture of the drum and a profuse bloody discharge. Three days later the staff otologist was called to see her because of pain and tenderness over the mastoid. He found a small perforation and enlarged it by incision. Tenderness and pain abated, and it was thought that recovery would follow in a few days. Seven days later there was a recurrence of the pain, and paracentesis of the drum was again performed. The pain and tenderness now persisted in moderate degree, and a week later I was asked to make a skiagram. The skiagram showed absolutely positive evidence of a breaking down of the entire mastoid, and the operation the following day, almost three weeks after the onset, verified the *x*-ray finding.

Mild Acute Mastoiditis. In the study of the milder acute cases an interesting problem presented itself. By the milder acute cases is meant those cases in which there are distinct demonstrable changes in the mastoid, but in which there is little or none of the gross destruction seen in the more severe cases. These cases may or may not progress to spontaneous recovery. The first change is that of fluid-filled cells; that is, the cell spaces, instead of standing out sharply and clearly, show by comparison with the opposite side that the air is displaced by a more solid substance, which may be serum, pus, or granulations, or all three combined. The cell walls are fairly distinct and not broken down. This appearance of fluid-filled (instead of air-filled) cells is very characteristic of this stage. And in our attempt to draw operative indications from the plate, the question as to how much bone change in the mastoid may occur without precluding spontaneous recovery, that is, what amount of skiagraphic bone change makes operation imperative,

presented itself. Of course, we did not attempt to decide such a weighty subject. In discussing the same, the fact that each textbook and each specialist has individual ideas regarding the pathology of acute mastoiditis is somewhat confusing. Those of the conservative school cite many instances of clinically severe mastoiditis which recover under the expectant treatment, whereas those of more radical tendencies advise early operative interference when fairly positive clinical evidence of mastoid involvement is at hand. The thought at once suggests itself, would it not be possible by means of the *x*-rays to decide this point, and by a comparative *x*-ray study of a large series of cases to determine what amount of bone destruction makes operative interference imperative, if indeed the question can be settled at all? Although our series of cases is far too small and too incompletely studied to warrant any definite conclusions, yet we adhere to the following tentative rule. If in an acute case the skiagram shows fluid-filled cells with little or no breaking down of cell walls, an expectant line of treatment is suggested, whereas, if the bone destruction is definite and considerable, operation is recommended.

The following two cases are typical of this milder type of mastoiditis:

Mrs. E., aged thirty-five years, had for ten days suffered with pain in the ear. Examination revealed, in addition to inflamed drum, pain and tenderness over the mastoid. There was some fever—100° in evening, 99.5° in morning. The drum was incised, but symptoms continued a week unabated. An *x*-ray examination made at this time revealed the mastoid cells fluid-filled, but little or no bone change. After two weeks, discharge gradually ceased and mastoid symptoms abated. Drum returned to normal, pain and fever disappeared, whispered voice heard at twelve feet. A second *x*-ray examination, made two weeks later, showed the affected mastoid apparently normal, the cells containing air.

Mrs. M., aged thirty-three years, suffered severe pain in ear following an acute rhinitis. Upon examination, drum was bulging, covered with hemorrhagic blebs, mastoid tender over antrum. Drum was lanced and few drops of serum exuded, followed by sero-

bloody discharge, which continued three days and suddenly stopped. Pain returned. Drum was again incised, and mucoserous discharge continued. Marked tenderness was present over mastoid and antrum, extending toward tip, but there was no fever. After several days discharge again stopped, and buzzing and throbbing pain were complained of. *X*-ray examination at this stage revealed a haziness of the cells just back of the mastoid antrum, but not extending over the rest of the mastoid. The slight changes seen in the plate did not seem to warrant any active interference. From this time the case went on to recovery, and a second plate (made two weeks after the first one) showed apparently a restoration to the normal.

Several cases similar to these were encountered at the Cincinnati General Hospital, but as the patients treated here usually insist on leaving before entirely recovered, and are then lost track of, the ultimate outcome could not be followed; of great interest would be some statistics as to how frequently such mild mastoid involvement goes on to ultimate recovery, and what percentage becomes chronic or gives rise to intercranial or other complications.

Acute Otitis Media. After being able to detect the milder changes in the mastoid, a small series of cases of acute otitis media without clinical signs of mastoiditis were examined. To our surprise, more than 50 per cent. of the cases skiagraphed gave evidence upon the plate of slight mastoid involvement. This involvement was indicated by a slight haziness of the cells just back of, or surrounding the antrum. The bone contours were, however, sharp and distinct.

The *x*-ray study of the mastoid region is submitted at this time as an aid in the obscure cases. A more extended study of a large series of cases will, it is hoped, put this work upon such a firm basis that, in any case, an *x*-ray examination may yield results so valuable as to justify the procedure.

But the work has a broader application. By repeated examinations the course of a single case may be studied. By extended studies over long intervals of months or years some light may be thrown upon the pathology of mastoiditis. The ultimate results of acute and chronic mastoiditis in early childhood, and its influence

upon the development of the mastoid and its relation to the auditory functions in later life may be determined. The end results of those types of mastoiditis which apparently recover without operation, and the relation of mastoid sclerosis to the capsule and functions of the internal ear, are problems which systematic *x*-ray work may help to solve. As a preliminary to such studies involving repeated exposures, it must first be determined at what intervals, and how many exposures may be safely given without causing alopecia, and what form of technique will best guard against it.

The cases of acute, subacute, and chronic otitis media in young children one to ten years presented such unique appearance upon the skiagram as to warrant special consideration. It was my priviledge to examine about 10 cases of this kind, which presented no marked clinical signs of mastoid involvement. Almost without exception the mastoid showed changes varying from a slight haziness of cells in the earlier cases to more or less bone destruction in the more severe cases, while the chronic ones showed pronounced sclerosis. Owing to the small size of the cells and the immature development of the mastoid, the amount of bone change is often hard to determine in these cases. Every case, however, showing such haziness of the mastoid which came to operation showed actual mastoid involvement, justifying operation. It would appear that in early childhood a majority of cases of otitis media are accompanied by distinct mastoid involvement. As mentioned above, the small size of the mastoid in these cases made it rather difficult to draw operative indications from the plate.

Following the papers by Dr. Coakley and Dr. Lange there was a Lantern Demonstration Illustrating the Diagnosis of Intrathoracic Lesions and Gastric Carcinoma by Dr. Henry R. Pancoast, Dr. Charles L. Leonard, Dr. George E. Pfahler, Dr. William S. Newcomet and Willis F. Manges.

DISCUSSION ON X-RAY SYMPOSIUM

Dr. B. Alexander Randall: I regard this demonstration of the anatomy and pathological conditions of the mastoid as of great interest and importance, although thus far I have not myself been able by personal experience to confirm much of it in practice. Believing, as I do, most heartily in the conservative dealing with mastoid disease, I appreciate that the *x*-rays afford an opportunity of confirmation of symptoms or of clearing up those cases where empyema of the mastoid is present undemonstrated by physical signs. The fact that operation evacuates pus does not demonstrate that operation was an actual necessity in these cases, and that the condition could not have been cleared up. Some of these empyemas, like those of the nasal sinuses, can drain and go on to cure without operation. The risk in awaiting such a thing is great. Cases where it can be waited for are few, but I believe much value will ultimately come from such a series of investigations.

Most important will be the occasional demonstration of such a case as was spoken of by the essayist in relation to multiple lesions.

I believe, however, that before we can reach definite conclusions, there must be a greater amount of agreement among aurists concerning the anatomy and pathology of the mastoid process. The frequency of the occurrence of the diploetic structure as compared with the pneumatic has not been agreed upon, and the earlier results of Zuckerkandl, of Cheatle, and my own are not in accord with each other or with those cited by Dr. Lange.

In a case which I demonstrated here twenty years ago, instead of the sclerotic process in the mastoid being a matter of thickening of the walls and obliteration in that way of the cavities, the cells of the mastoid were each definable, but filled with solid bone, leaving but a single chain of cells not thus eburnated.

Dr. S. MacCuen Smith: I wish, in the first place, to express my belief, borne out by experience, that it not only requires an expert to make the radiograph, but an equally skilled man to interpret it. This is shown in the fact that Dr. Lange has been able to point out, in a picture of an acute case of mastoiditis, a serous from a purulent discharge. As has been stated, this will enable us to determine more accurately those cases which require early operation and not run the risk of allowing them to go for an indefinite time.

Although not of diagnostic value, if there is a good outline of the ossicular chain, we can feel that the surrounding structures, as indicated in the radiograph, are accurate. While not able to point out definitely acute abnormal conditions of the mastoid, in a certain number of cases the shadow shows the presence of disease.

Dr. Lange states that in acute inflammatory conditions of the middle ear he has found 50 per cent. with mastoid involvement. In this connection it is well to remember that the mastoid is more or less involved in all acute inflam-

matory diseases of the middle ear. The great majority of these, however, clear up without operative interference.

Up to the present time we have not been able to demonstrate the presence of a thrombus of the sinus or definitely locate an abscess formation within the interior of the skull. At the same time we are frequently shown the abnormal position of the sinus in chronic cases, which is of great advantage to the operator, as otherwise the sinus might be more frequently injured on account of this abnormality.

A few months ago I operated upon a woman who complained of pain over the mastoid and who had a blister applied. It was difficult to state whether the pain was due to mastoid disease or to the blister. An *x*-ray photograph showed that there was some trouble with the mastoid. Operation was performed, and although the woman never had had a discharging ear or any aural disease whatever, the bone was found necrotic far back, and posterior to the sinus the pus had burrowed down to the dura and half way back to the occipital protuberance. This was plainly shown in the *x*-rays.

In another instance I operated upon a man, aged forty-five years, for suppurative otitis media. The sinus was shown to be far forward, the posterior wall of the external auditory canal acting as the anterior wall of the sinus.

A third case, seen with a dentist, was that of a woman who complained of attacks of neuralgia starting in the superior maxillary of the right side. These attacks occurred so frequently that her friends would say she had one of her "neuralgic spells." *X*-ray photographs showed a tooth running parallel to the jaw, and its removal gave relief.

I feel that the *x*-rays are in their infancy, and if the progress made in the last few years is to continue, they cannot help but be of ever-increasing value in both medicine and surgery as a diagnostic aid.

Dr. F. R. Packard: Dr. Coakley has dwelt on the *x*-rays as a means of diagnosis, as regards the presence or absence of pus, and their value in the determination as to whether an external or internal operative procedure is indicated.

In my mind, the special value of the *x*-rays for sinus work lies in their use as a guide to the operative field. They enable the operator to acquire a familiarity with the field of operation that it is otherwise impossible to attain. They not only show whether the sinuses are present or absent, and whether they contain pus or not, but they indicate their size and configuration, their relation to one another, the presence or absence of septa, and other points which are of the greatest value to the surgeon.

Dr. E. B. Gleason: When we remember how absolutely unreliable are almost all the symptoms of mastoiditis as indications for operation, we cannot but value the magnificent work of Dr. Lange's. Otorrhea may continue for weeks without mastoid symptoms, except possibly slight tenderness on

pressure over the antrum, and suddenly there may occur fever, great pain and tenderness on pressure over the antrum, sleeplessness, complete loss of appetite, and sagging of the upper posterior position of the canal next the drumhead. Under such circumstances immediate operation frequently shows a greater amount of caries than could possibly occur after the onset of serious mastoid symptoms. However, temperature and tenderness over the mastoid antrum are not indications for operation. There is just one sign which, when it is present, always indicates operative treatment—bulging of the posterior portion of the auditory canal near the drumhead. It is usually present within a few days after the onset of otorrhea.

Perhaps the most striking of all the points brought out in Dr. Lange's paper is the extensive involvement of bone that may occur in cases that recover without operation. Of five cases of mastoiditis sent to me for operation at nearly the same time, one year, four recovered without operation. Today I saw a case that came to me once or twice last January, whose head had been shaved about the left ear at one of our hospitals, preparatory on the fifth day after the commencement of an otorrhea. Sickness of the aurist prevented operation for some days, and the woman left the hospital. At that time there was double otorrhea and tenderness over both mastoids. No operating was done and both ears are well and the hearing entirely normal.

I do not want to criticise too severely gentlemen who, as a matter of routine, operate for mastoiditis within a few days after the appearance of an otorrhea, and go through nearly normal bone down to the antrum, because there results ordinarily a speedy cure of the otorrhea, and hence we may look upon an operation of that kind much as the general surgeon looks upon an exploratory incision, but at least 80 per cent. of the mastoiditis that occurs during the first week of otorrhea will get well without operation. If, however, the surgeon wishes to operate on such cases he will have a series of very good results, and there is no special harm done. When the surgeon prefers to operate as I do, only in cases that will not get well without operation, a series of *x*-ray plates of the inflamed mastoid would furnish valuable information in a doubtful case as to how long it would be safe to wait before resorting to an operation.

Dr. Joseph Sailer: I have had a number of intrathoracic diseases examined by the *x*-rays. In a pulmonary case the *x*-rays are of value, partly by substantiating the physical signs and largely as an important factor in the prognosis of the case. Physical examination may reveal only slight signs, although the *x*-rays show general involvement of the lung, and the prognosis is, therefore, bad. In cases in which the physical signs may be locally well pronounced, the *x*-rays will show that the rest of the lung is in fairly good condition, thus making the prognosis more favorable.

In gastric conditions I have observed two cases in which the radiographer

and I believed that an hourglass contraction of the stomach existed. In both cases operation showed the existence only of extreme gastroptosis. I have inferred from these two cases the possibility of misinterpretation of the radiographs because of temporary spasms of the walls of the stomach.

Dr. Lange, closing: I believe there is not one case of mastoiditis in which, if the skiagram is properly made, important evidence will not be yielded for the clinician. In showing these lantern slides, which do not lend themselves to a fair representation of the conditions, I am perhaps doing the work an injustice. The original plates are here in the city and I should be glad to demonstrate them to anyone who desires to see them. When viewed by the soft light all the finer details can be brought out.

Without doubt bone necrosis in the mastoid can heal spontaneously. That has been proved post mortem, and by the fact that in operating the mastoid is often found filled with pus and granulations, showing that, if left to itself, granulations may organize and the process heal. Yet the fact that the necrotic mastoid may heal should not restrict operations because pus tends to burrow deeply, and instead of resolution a serious complication may follow. I think Dr. Smith misconstrued my statement. I did not say that we could diagnosticate serum distinctly from pus, but that there is a stage of acute mastoiditis in which there are, just back of the antrum, cells filled with fluid, which fluid may be pus or serum, or both.

VEIN-TO-VEIN TRANSFUSION OF BLOOD[1]

By GEORGE MORRIS DORRANCE, M.D., and NATE GINSBURG, M.D.
PHILADELPHIA

(From the Laboratories of Experimental Surgery in the University of Pennsylvania)

In a previous paper, dealing with the transfusion of blood in the human species, we presented a summary of the literature on this subject and a description of both the old and modern methods of performing transfusion. At the present time, the method in vogue in the performance of this operation is the direct junction of the vessels either by suture or some mechanical appliance. We intend to discuss only certain features pertaining to the operation, and we offer this preliminary report, which is based on the development of a new technique, under three heads: (1) The advantages of the vein-to-vein method of performing transfusion over the arteriovenous method; (2) the indications for employing transfusion; (3) the contraindications to transfusion.

1. Advantages. The artery-to-vein method has been advocated in the last few years by investigators of the subject, notably by Crile. Anastomosis of the vessels is established either by means of a modification of Payr's original tube or by direct suture of the vessels. Tubings of various types are also advocated, especially by Brewer.

At the best, the operation is a delicate one and should be performed with a full realization of the risk, both to the recipient and to the donor. To the recipient the dangers incident to the transfusion are the transmission of disease, hemolysis, and acute dilatation of the heart. The first of these is readily eliminated by a careful inquiry for a history of syphilis or other transmissible disease,

[1] Read May 4, 1910.

supplemented by a rigid physical examination. With regard to hemolysis, the conditions necessary for its occurrence are as yet imperfectly known, and the clinical tests proposed for their detection have not proved of much practical value. We have not, thus far in our experience, had a case of hemolysis. In the case reported by Pepper and Nesbit, obscure changes were undoubtedly present before transfusion was done.

Acute dilatation of the heart from overengorgement is a grave accident which cannot always be avoided when the arteriovenous method is employed, even by the exercise of all possible care on the part of the surgeon. As will be shown later, however, this accident is practically impossible with the vein-to-vein method of transfusion, because the principal factors in its production, namely, increased pressure and volume of the blood stream, are eliminated.

The advantages claimed for the employment of the arteriovenous method of transfusion are: (1) That sufficient blood pressure is obtained to introduce the blood quickly from the donor into the circulation of recipient, and (2) that the blood obtained is richer in oxygen content. On the other hand, the method suffers from various disadvantages.

(*a*) The operation itself is beset with many technical difficulties, and should not be attempted by anyone who has not perfected his skill by repeated experiments on animals.

(*b*) The size of the vessels can never be determined beforehand. Frequently the radial artery is found to be so small that some other artery must be exposed for use. The impression of the size of the peripheral arteries which one gains in the dissecting room is erroneous, since, in the living subject, they are of considerably narrower lumen than those observed in the cadaver.

3. The pressure and volume of the blood stream, when the arteriovenous method is employed, are sometimes so great as to cause acute dilatation of the right heart, which is a grave complication, appearing rapidly and frequently proving fatal. It undoubtedly explains some of the sudden deaths that occur during transfusion. In Crile's animal experiments acute dilatation was often noted, and Cole and Winthrop mention it in their work. We have observed it twice in our human cases, and for this reason the vein-to-vein method suggested itself to us.

The technical difficulties encountered in the arteriovenous method of performing transfusion have led to the development of various instruments, principally modifications of the original Payr's tube. Under the most favorable conditions, even in the hands of an experienced operator, attempts at transfusion will often fail, but failure in these cases is due to insuperable obstacles, such as abnormally small or sclerotic arteries, or deep-seated vessels buried in a thick layer of adipose tissue.

In vein-to-vein transfusion, on the other hand, the surgeon is dealing with the superficial vessels, which are easy of access. Moreover, a gradual flow is obtained, so that danger of engorgement and the resulting sudden dilatation of the right heart are avoided. The size of the structures and the ease of access make it a simpler procedure than the arteriovenous method. The principal advantage we suggest for the vein-to-vein method of performing transfusion is its simplicity. There is no danger to be considered except the possible one of hemolysis.

2. Indications. The basis for classification of the diseases or acute emergencies necessitating the performance of transfusion has been previously stated at some length. In general, transfusion is employed either to save life or to hasten the patient's recovery. After severe hemorrhage we have two conditions to fulfil—first, to make up for the loss of fluid in the patient's blood-vessels, and second, to increase the number of oxygen-carriers (red corpuscles). The first of these conditions can be fulfilled by the injection of saline solution, either subcutaneously or intravenously. The second can be fulfilled only by the transfusion of human blood.

The indications for performing transfusion are, therefore, as follows: The sudden depletion of the vascular system due to grave accidents, or following operations, as in the case of severe tonsillar hemorrhage, and in hemorrhage occurring during the course of typhoid fever; hemophilia; melena; poisoning with carbon dioxide, coal-tar derivatives, and other substances characterized by the production of methemoglobin; and pellagra, in which the transfusion of blood from a patient who has recovered from the disease has been found beneficial in a number of reported cases.

3. Contraindications. It is of no value in severe infections, in the cachexia of cancer, and in tuberculosis. In pernicious anemia and in leukemia, transfusion has disappointed the great expectations which the introduction of the method aroused for the cure of these hopeless conditions. Transfusion is decidedly harmful in cases of purpura hæmorrhagica and whenever hemolysis is taking place.

The above claims are based on experiments performed on dogs. The transfusion of blood was obtained by employing veins, as jugular to jugular, or, better, jugular to femoral, in this way eliminating any possible negative pressure or suction. No difficulty was encountered in successfully transfusing enough blood to resuscitate a dog that was practically exsanguinated. This experiment could be repeated again and again on the same dog by clamping the donor's vessel and bleeding the recipient until practically pulseless; the clamp was then removed and the blood allowed to enter the recipient's circulation until the pulse and respiration returned to normal, while symptoms of hemorrhage developed in the donor. Communication between the veins was established by means of Sweet's modification of Payr's tubes.

In concluding, we wish to express our appreciation of the services rendered by Messrs. Burleigh, Hayward, Pitt, and McElhone, undergraduates in the University of Pennsylvania.

DISCUSSION

Dr. A. P. C. Ashhurst: My experience with transfusion has been very limited. I had the pleasure of doing my first experimental work in this direction in the laboratory of Dr. Crile, in Cleveland, on a dog. I found it very much easier than I had expected. Since then I have been on the lookout for cases in which transfusion could be employed, but so far have found only two. Both of these occurred at the Episcopal Hospital in the service of Dr. Frazier. The first case was a traumatic amputation of the upper arm. The patient was very weak, due to the shock and hemorrhage, and although the transfusion was successfully accomplished, the patient showed such indubitable signs of impending death that the operation was hastily concluded and he was removed to his bed, where he died.

The second case was one of hemophilia, with marked anemia resulting from the hemorrhage. In this case, though the anastomosis was very much less easily accomplished, the transfusion was continued until a faint pink color

returned to the boy's lips, and improvement was steady from that time on, the child being now in excellent health.

I was struck in these operations by the fact, noted by Dr. Dorrance, that the radial artery in the human being is much smaller than one expects to find it. The arteries of the donors in these cases were very small. In one case, though the man was only about forty years of age, his arteries were calcareous, and it was very difficult to spread the radial over the end of Crile's cannula which I used in connecting the artery with the vein. I think if the operation of vein-to-vein transfusion is easier and accomplishes the same results, it is worth while trying.

HEMICHOREA, HEMIATAXIA, HEMIPARESIS, AND DILATED PUPIL, PROBABLY DUE TO A LESION OF THE SUPERIOR CEREBELLAR PEDUNCLE*

By CHARLES K. MILLS, M.D.
PROFESSOR OF NEUROLOGY IN THE UNIVERSITY OF PENNSYLVANIA

Mrs. C., a widow, aged fifty-one years, was first seen by me on November 23, 1909, having been referred by Dr. M. S. Mengel, of Elverson, Pa., and Dr. John Wells, Chester Springs, Pa. About six months and a half before coming under observation she had a seizure which left her somewhat incapacitated or paralyzed on her right side, arm and leg. The attack came on while she was walking around. She first had an unnatural feeling in her right arm, then in her leg, and both members gradually got so that she could not use them properly. Speech was not affected. She was not unconscious at any time.

For several weeks previous to the apoplectiform seizure she had had at times a swimming or giddy sensation, and had also a little headache above the left eye, and ever since she has continued to have some pain in this region.

It was evident at first sight that her arm was the seat of a continuous tremor, which increased when she used it.† The tremor was of a moderately coarse type. The oscillating hand was held slightly flexed and some movement was present in the entire arm. When sitting quietly this tremor did not affect the leg, but the leg became somewhat affected during walking. Putting her hand on a flat surface, as on the table, the tremor ceased temporarily. The patient said also that the hand did not shake when she was lying in bed, awake or asleep. The movement was increased by a

* Read May 4, 1910.

† The symptoms here described are a summary of the results obtained on several examinations made during the week or ten days after she first came under observation.

volitional effort to hold up the arm away from the bed. Studying the movement more closely, it was seen to be slightly jerky, with a partial extending and flexing of the hand at the wrist. The head and face were not affected by the movement, but she had what she described as a sense of "drawing" in the right side of the face.

Some loss of power was present in the right upper extremity, and to a less degree in the lower extremity of the same side, as indicated by her ability to perform active movements and to resist passive movements. She had much difficulty in using the hand and fingers in performing finer movements, such as buttoning and unbuttoning her clothing. She showed weakness and awkwardness in the right arm in attempting the finger to nose test.

She was tested in various ways for powers of orientation and muscular sense. In having her blindfolded and attempting to move each arm through the same space, she did this awkwardly with the right arm and hand, although the space covered did not differ much on the two sides. Testing her by holding the fingers laterally and moving the parts on their joints, she was unable to repeat these movements or to reproduce the position properly with the unaffected hand. Besides testing with finger movements, sense of position was also studied by movements of the larger joints, as the wrist and elbow, with the same result, that is, the examination indicated the loss of the sense of position and passive movement.

Efforts were made to have her mark out on a ruler distances like an inch, or several inches, or parts of an inch, with the separated finger and thumb of each hand. She did this with fair precision with the unaffected hand, but in attempting to carry out the test with the right finger and thumb she exhibited much awkwardness. She marked the distance on the ruler nearly correctly, but her finger hovered and shook in the attempt. She had well-marked astereognosis in the right hand, not being able to recognize various objects with the fingers and hand of this side, these objects being promptly recognized by the left hand.

Several examinations were made to test her various forms of sensibility. The senses of pain and touch were not impaired. Spot localization was preserved. She did not always touch with precision the spot touched by the investigator. This was appar-

ently due to uncertainty in the use of the unaffected hand rather than to real impairment of the sense of location. The sense of pressure was preserved.

One of the most interesting results obtained in this case was with regard to tactile discrimination. Testing with the compass points, the patient could not recognize them at twice the distance on the right hand, back and front, that she could on the left hand—indeed, she could scarcely recognize them as distinct points at any separation.

These tests were repeated with the same result at different examinations. The conditions as to impairment of power, sense of position and sensation were the same in the lower as in the upper extremity, but were not so marked.

Ptosis was not present and the ocular movements were not impaired. The right pupil, however, was somewhat larger than the left.

The following report by Dr. S. D. Risley, to whom the case was referred for ophthalmic examination, is of interest.

"A careful study of Mrs. C.'s ocular condition shows normal sharpness of central vision through correcting glasses. The fields of vision are also normal and the ophthalmoscope reveals only too full retinal veins, suggesting a possible increased blood pressure, but probably not too high for her age. The only thing I can discover about the eyes which may throw any light upon her intracranial disease is the fact that while both pupils react promptly, the right is larger than the left, the relative difference in size being greater in the diffused light of the consulting room than when facing a strong light with both eyes. This suggests an impairment of the light sense in the right eye, probably due to some disturbance, a stimulus possibly within the reflex arc or impaired perception at the oculomotor nucleus or higher up."

The urinary analysis showed an acid reaction, specific gravity at 15° C., 1023. A trace of albumin was present, but sugar was not found. The microscopic examination of the urine showed a few uric acid crystals and a few oxalate crystals; leukocytes present; squamous epithelial and numerous deep tissue cells; a few hyaline casts and various cylindroids.

This case is of much interest as the representative of a com-

paratively rare symptom complex. In the main it is that which is sometimes spoken of as the Benedikt syndrome. The lesion in this case was probably one involving the peduncle and the nucleus ruber. In lesions of the peduncle some form of oculomotor paralysis is present on the side of the lesion, with hemiplegia or hemiparesis on the opposite side. In connection with this, in the so-called Benedikt syndrome, a tremor which has sometimes been spoken of as like that of paralysis agitans may occur on the paretic or paralyzed side. The oculomotor trouble may be partial or total, or may even involve both sides, according to the extent of the lesion. In this case, if the dilated pupil is to be regarded as a form of oculomotor paresis, this involvement was very partial. According to some the tremor is rather of the intention type than of the type of paralysis agitans. If the lesion involves more of the tegmental region, hemiataxia may occur with, as in our case, loss of the sense of position. Leube[1] cites a case of hemiataxia, the oculomotor involvement consisting only of a constant ptosis and dilatation, the dilatation occurring later, but no other involvement of ocular muscles. Slight athetosis was present in both feet, but no distinct tremor or ataxia. Some sensory changes were also present on the paralyzed side in this case. Necropsy showed numerous small hemorrhagic areas in the peduncle and tegmentum.

Southard, in Vol. VII of Osler's *Modern Medicine* (Chapter XV, on Encephalitis and Brain Abscess), cites a case of Combe's illustrating a peculiar combination of symptoms in encephalitis with multiple foci: "That form of alternate paralysis known as Weber's syndrome," says Southard, "viz., right hemiparesis and left ophthalmoplegia, appeared in a boy aged two years. Weir Mitchell's[2] post-hemiplegic choreiform movements followed on the right side, but associated with spasmodic movements in the field of the left facial and abducens nerves, amounting to an alternating hemichorea. Later there was weakness of the right oculomotor nerve. Such hemiparesis with crossed paralysis of the oculomotor nerve, with tremors of the paralyzed parts, corresponds with Benedikt's syndrome (due to a lesion of the cerebral peduncle), but the involvement of the left facial and abducens nerves, together with the right-sided hemiparesis, amounts to the Millard-Gubler syndrome. The patient, therefore, suffered from a combination of Benedikt's

syndrome and the Millard-Gubler syndrome, due to a lesion of the pons near the left pyramidal tract (this new syndrome Combe proposes to call the inferior Benedikt syndrome), but in addition showed a complication by incomplete ophthalmoplegia, due to a separate lesion situated in the oculomotor nuclei."

This case was unlike the one here presented, in that it showed no sensory involvement and was located too far spinalward. It is, however, in some respects similar, as in the presence of the tremor on the hemiparetic side.

Bonhoeffer,[3] after referring to some cases of others and to two cases of his own, one with necropsy, speaks of the theories which have been advanced in the explanation of the hemiplegic or post-hemiplegic disorders of movement.

Kahler and Pick[4] believe that this movement was due to irritation of the pyramidal tracts.

Anton, cited by Bonhoeffer, published a case of bilateral choreoid movements, in which the necropsy revealed a bilateral lesion situated in the putamen of the lenticula. The same author, Anton, mentioned another case in which the lesion was in the thalamus.

Meynert and Nothnagel made similar observations earlier.

Anton believes in the existence of an antagonism between the lenticula and the thalamus. The lenticula, or certain parts of it, exercises an inhibitory influence over automatic impulses. Therefore, a destructive lesion of the lenticula interfering with the inhibitory influence would permit movements which would otherwise be controlled. The thalamus, on the other hand, exerts an accelerating influence over automatic impulses. The result, naturally, according as the lesion was irritative or destructive, would be the production or the suppression of the movement. According to this theory an equilibrium is established as regards coördinate movements between the lenticula and the thalamus. Anton calls attention to the observations of Freud, that the movements of infants and youthful children are of a choreoid nature, and also to the fact that in the diplegias occurring in childhood, such athetoid movements are of frequent occurrence.

Bonhoeffer calls attention to the well-known facts that in the

early stage of hemiplegia choreoid movements are absent, and first present themselves with the return of some voluntary power, these increasing in proportion to the return of this power and the efforts at voluntary movement.

Bonhoeffer refers to an apoplectic case in which choreiform movements were present with marked hypotonia. This hypotonia was almost to the extent of a complete flaccidity. In this case, as in others, while impairment of power was present, it was not of the character which is seen in lesions of the pyramidal tracts.

Pineles, von Monakow, and Bernard Sachs also call attention to hypotonic flaccidity in cases of hemiplegic and post-hemiplegic chorea, so called. In ten of eighteen cases of Freud's with choreiform movements, contractures were absent. These facts, according to Bonhoeffer, contradict the theory that such movements are due to irritation of the pyramidal tracts. They are rather, according to him, due to interference with centripetal pathways. According to Bonhoeffer we have three positive reasons for the theory that choreoid-athetoid movements are due to lesions of the tract passing centripetally from the cerebellum to the motor cortex: (1) The constant occurrence in cases with these movements of a lesion of the superior cerebellar peduncle or its continuation into the subcortical ganglia. (2) The hypotonia of the musculature in such cases. (3) The disturbance of the voluntary movement occurring in chorea in addition to the involuntary movements present.

Bonhoeffer refers to the fact that Gowers had spoken of the occurrence of the athetoid movements in cases of cerebellar lesion. Von Monakow believed that impulses from the subcortical lesion passed to the motor cortex and there acted upon the pyramidal system in such a way as to cause the irregular (choreoid-athetoid) movements. Bonhoeffer agrees with von Monakow in so far that he holds that these choreiform movements are caused by interfering with the tracts which go from the tegmentum cortexward and under normal conditions serve to steady movements controlled by the pyramidal system. He believes, however, that while some tracts go from the tegmentum to the cortex, others pass into the subcortical ganglia (nucleus ruber and thalamus), and according as one or the other of these tracts is interfered with, will be the effect. If the cortical tract is cut off, the impulses will go by a short cut through

the nucleus ruber, and in this way the incoördinate movements may be brought about. There is a flow of automatic movement in the ganglia, and according to the extent of the lesion will be the effect in motor symptoms.

He states that he had the opportunity of observing a case with accumulating symptoms and also impairment of power and movement gradually growing, in which, in the necropsy, he discovered a lesion about the size of a cherry at the decussation of the two superior cerebellar peduncles. Reasoning from this case and other data, he concludes that tracts pass from the cerebellum to the red nucleus, and other tracts from the cerebellum to the thalamus and to the lenticula, and that a lesion of any of these tracts might give rise to disorders of movement of a choreoid or athetoid character. It follows, therefore, that a lesion in the superior cerebellar peduncle, if situated at a certain part, would give rise to such manifestations. Bonhoeffer cites cases of Newton and Sander in support of his decision. In the former the lesions were in the neighborhood of the nucleus ruber, and in the latter in the region of the corpus dentatum in the cerebellum.

BIBLIOGRAPHY

1. W. von Leube. Spezielle Diagnose der Inneren Krankenheiten, vol. ii, 7th edition, 1908.

2. S. Weir Mitchell. Postparalytic Chorea, American Journal of the Medical Sciences, October, 1874, vol. lxviii, n. s.

3. K. Bonhoeffer. Zur Auffassung der Posthemiplegischen Bewegungsstorungen, from Monatssch. f. Psychiatrie und Neurologie, 1910, vol. x.

4. Kahler, Pick, Anton, Meynert, Nothnagel, Pineles, von Monakow, Sachs, Freud, Gowers, Newton, and Sander are all cited by Bonhoeffer in the article referred to above.

DISCUSSION

Dr. George E. de Schweinitz: The Chair would like to ask Dr. Mills whether there was paralysis of the ciliary muscle as well as mydriasis.

Dr. Charles K. Mills: There was simply the dilated pupil. There was not a true ophthalmoplegia. The pupils on both sides responded to light. This dilatation of the pupil was more evident in diffused light than it was in concentrated light (although present in both).

THE DIFFERENCE BETWEEN SYSTOLIC PRESSURE IN THE ARM AND IN THE LEG IN AORTIC REGURGITATION[1]

By H. A. HARE, M.D.

The sphygmomanometer has done much within the last few years to increase our knowledge of blood pressure, and gives us, when properly used, valuable facts in the fields of prognosis, diagnosis, and treatment. I desire in this brief note to call attention to the observations of Leonard Hill to the effect that in aortic regurgitation there is a remarkable difference in systolic pressure found in the arm and leg, the pressure in the lower limb being often extraordinarily high, not rarely amounting to 100 millimeters of mercury above that of the upper extremity. The results which I have obtained in making comparative studies of the blood pressure in the arm and leg of cases of aortic regurgitation have not only confirmed Hill's conclusions, but have given me even greater variations than he records, and I am prepared to agree with him that this extraordinary difference between the systolic pressure in the arm and leg is a pathognomonic sign of aortic incompetence, as it is not present in other valvular lesions.

Hill's paper, which was published in the first issue of the new periodical called *Heart*, first discusses the difference in the systolic pressure in the arm and leg in health. He finds, as have all other investigators in this field, that the difference in health is not great provided the patient is recumbent, so that the arm and the leg are on about the same level, a large part of the difference in the arm

[1] Read June 1, 1910.

and leg being due to gravity. In other words, the systolic pressure in the leg and in the arm is practically the same, provided the patient is perfectly horizontal and at rest for some time before the examination; the variation rarely exceeding from 10 to 15 millimeters.

One of Hill's assistants, who was carrying out observations upon blood pressure under his suggestion, reported to him that in some cases of aortic regurgitation this normal ratio did not exist, and Hill soon found that his assistant's observation was correct. Thus, he speaks of one instance in which the systolic pressure, in a case of aortic regurgitation, in the arm was 130, but in the leg 195. In another case it was 150 as compared to 200. In a third case, 160 to 240; and in still another the pressure in the arm was 106 and in the leg 156. Three other cases gave a ratio of 118 to 172; 130 to 220; and 130 to 180. In my own cases the systolic pressure was taken by three instruments—the Tycos, Stanton's modification of the Riva-Rocci instrument, and the new and interesting instrument of Pachon. In some tests the Tycos instrument could not be employed, as its highest register is 260. As will appear below, one of these cases showed a pressure in the leg far in excess of this figure.

In one of my cases this method of reaching a diagnosis of aortic regurgitation proved most helpful because the ordinary characteristic symptoms of this disease were not well marked. The pulse was somewhat trip-hammer in character, but not sufficiently so to be typical. Auscultation revealed a double murmur, very feeble in character, and equally well heard in the mitral and aortic areas. There was a systolic murmur transmitted into the carotid, but the diastolic murmur could not be separated from that of mitral stenosis or Flint's murmur. In this case it was found that the systolic pressure in the arms was 160 and in the legs 260. On taking the patient where there was a good light, Quincke's capillary pulse was found in the skin and in the lips.

In another case the arm pressure was 170, the leg pressure 265.

The following tables give the results from the examination of three cases of aortic regurgitation and from several others repre-

senting various types of disease—circulatory or otherwise, but without aortic lesions. It will be noted that there is practically no difference in the blood pressure in the arm and leg except in the cases of aortic regurgitation:

Aortic Regurgitation.

Right arm, systolic, 170 mm. of Hg.
Right arm, diastolic, 135 mm. of Hg.
Right leg, systolic, 265 mm. of Hg.
Right leg, diastolic, 220 mm. of Hg.
(Taken with a Stanton instrument.)

Aortic Regurgitation.

Right arm, systolic, 160.
Right leg, systolic, 260.
(Taken with a Stanton instrument.)

Aortic Regurgitation.

Right arm, 140 mm. of Hg.
Right leg, 220 mm. of Hg.
(Taken with a Tycos instrument.)

Mitral Regurgitation.

Right arm, systolic, 130 mm. of Hg.
Right arm, diastolic, 95 mm. of Hg.
Right leg, systolic, 155 mm. of Hg.
Right leg, diastolic, 120 mm. of Hg.
(Taken with a Stanton instrument.)

Mitral Stenosis.

Left arm, 130 mm. of Hg., systolic.
Left leg, 140 mm. of Hg., systolic.
(Taken with a Tycos instrument.)

Enlarged Mediastinal Glands.

Left arm, systolic, 165.
Right leg, systolic, 165.
(Taken with a Stanton instrument.)

Pulmonary Tuberculosis.

Left arm, systolic, 130.
Left leg, systolic, 140.
(Taken with a Stanton instrument.)

Convalescent Croupous Pneumonia.

Right arm, systolic, 130 mm. of Hg.
Right leg, systolic, 140 mm. of Hg.
(Taken with a Tycos instrument.)

Convalescent Croupous Pneumonia.

Right arm, systolic, 110 mm. of Hg.
Right leg, systolic, 115 mm. of Hg.
(Taken with a Tycos instrument.)

Convalescent Croupous Pneumonia.

Right arm, systolic, 138 mm. of Hg.
Right leg, systolic, 155 mm. of Hg.
(Taken with a Tycos instrument.)

The explanation of the remarkable variation between the systolic pressure in the arm and in the leg in aortic regurgitation is by no means easy. Hill believes that the great systolic wave of aortic regurgitation is better conducted by the leg arteries, and that these vessels are maintained in a contracted state to secure an adequate supply of blood to the brain. If this theory is true, nature, in endeavoring to supply the brain with blood, devises a plan whereby a far greater strain is placed upon the incompetent aortic valves.

Hill also found that violent exercise may produce a condition of high pressure in the lower extremity somewhat similar to that found in aortic disease. He caused young men free from cardiovascular lesions to run up and down stairs. In one instance the arm pressure after this exercise was 168, whereas in the leg it was 240. It is evident, therefore, that when these comparative studies are made for diagnostic purposes the patient should have been at rest for some time.

Another interesting observation made by Hill is that the high systolic pressure of the legs in aortic incompetence can be removed by immersing the legs in hot water. Thus, in one patient the arm pressure was 110, the leg pressure 170. But after the foot was immersed the arm pressure was still 110, but the leg pressure only 140. After the foot had been allowed to become cool, the original ratio of 110 to 170 was restored. In still another case

the arm pressure was 122, the leg pressure 208; but after immersion in hot water the ratio was 120 to 152. The leg was then cooled artificially, and the ratio became 120 to 172, and later 120 to 190.

If Hill's theory, to the effect that the high pressure in the legs is designed by nature to supply the brain with blood, is correct, the rapid lowering of pressure in the legs by immersing them in hot water when the patient is sitting up should theoretically produce faintness or actual syncope. Hill does not state that this accident occurred in the course of his experiments. It occurred to me that this supposititious danger could be avoided and the same relaxation of the bloodvessels in the lower limbs produced by having the patient remain in bed, wrapping his legs in a hot pack, since under these circumstances there will be less tendency to disorder of the circulation at the base of the brain. The results obtained by me under these circumstances are as follows:

Case I

Pressure in the right arm, 200.
Pressure in the right leg, 290.

During the pack:
Pressure in the right arm, 190.
Pressure in the right leg, 220.
A decrease of 70 millimeters in the leg.

After the pack:
Pressure in the right arm, 190.
Pressure in the right leg, 275.
A rise of 55 points in the leg.

In another case the

Pressure in the arm was 150.
Pressure in the right leg was 255.

During the pack:
Pressure in the right arm was 150.
Pressure in the right leg was 230.
A drop of 25 points in the leg.

After cold had been applied to the legs in this case, in place of the hot pack, the pressure in the right arm was 150 and in the right leg 235. A few minutes later the leg pressure rose to 240.

The same experiment repeated in one of these cases with the Pachon apparatus gave the following results:

In the right arm the pressure was 275; in the right leg 350 plus; how much more I could not tell. During the pack the arm pressure fell to 245, but the leg pressure remained at 350 plus.

The extraordinary degree of pressure in the lower extremity was so great that even the Pachon apparatus could not register all of it. It was because the pressure was so great that neither the Tycos nor the Stanton instruments could be employed.

In another case tested with the Pachon apparatus the pressure in the left arm was 175; the left leg 240. During the pack the pressure in the arm was 170 and in the left leg 200—a fall of 40 points. After the pack the arm pressure was 170, the leg pressure 210—a condition which was maintained after the leg had been chilled by cold applications.

The following results were obtained in a case of aortic regurgitation on giving amyl nitrite. Before the use of the drug the pressure in the right arm was 160, in the right leg 245. During the effect of the nitrite it was 135 in the arm and in the leg 190.

In a case of aortic regurgitation with aneurysm of the aorta, occurring in a woman, aged about fifty-six years, the following results were obtained:

Right arm, 110; right leg, 220; left arm, 150; left leg, 195. The next day the right arm was 120; right leg, 210; left arm, 155; left leg, 200. The day following the right arm was 110; right leg, 190; left arm, 135; left leg, 210. The fourth day the right arm was 95; right leg, 185; left arm, 130; left leg, 220. The last two days the patient was under fairly full doses of nitrite of sodium.

It is interesting to note that the pressure in the right arm was always lower than the pressure in the left arm; but this is not true of the pressure in the right leg. Before the nitrite was given the pressure in the right leg was 220. After it had been taken for two days it was only 185 in this leg. On the other hand, before the nitrite was used the pressure in the left leg was 195; but after nitrite had been used it was 220. In other words, the maximum systolic pressure in the right leg before nitrite was present in the left leg after nitrite.

It would seem that these results as to the difference in pressure in the arms and legs in aortic regurgitation are not only of diagnostic value, but of therapeutic usefulness as well. In a case of aortic regurgitation there are two important points to be considered. If the peripheral vessels are relaxed, particularly those in the lower part of the body, the vital centres may fail from lack of blood supply, in that the heart is unable to maintain a cerebral circulation because, with incompetent aortic valves on the one hand and relaxed arterioles on the other, normal cerebral pressure cannot be maintained. On the other hand, if the vessels in the legs are contracted to the great degree that these experiments seem to indicate, the strain on the aortic valves must be enormous and the quantity of blood which regurgitates must be greatly increased. Given a case of aortic regurgitation with ruptured compensation, it would seem unwise to use the hot foot bath of Hill, but it would probably be safe to use the hot pack with the patient in the recumbent posture, since under these circumstances the brain would still receive enough blood, yet the resistance offered to the action of the heart by the previously contracted leg vessels would be diminished.

It is interesting in this connection to note that the patient who had so high a pressure as 350 millimeters in the leg soon found that a nitrite of amyl pearl would give him immediate relief if he was seized with cardiac pain during the night. A hypodermic injection of nitroglycerin was also efficacious. If nature designs the high pressure to supply the brain with blood, the use of the nitrite ought theoretically to relieve the cardiac strain, but produce cerebral anemia, which it does not do. So, too, if there is a demand on the part of the brain for more blood, the average case of aortic regurgitation should be more comfortable lying prone than when propped up in bed, yet the latter position is the one which is universally resorted to by these patients.

It would seem, therefore, that these observations provide a useful means of diagnosis, but Hill's hypothetical explanation of the phenomenon does not strike me as being adequate.

DISCUSSION

Dr. George W. Norris: I would like to ask Dr. Hare whether at the time this very high blood pressure of 350 mm. was registered there was any local edema which could account for such enormous pressure? Also, whether the diastolic pressure followed the rise in the systolic pressure?

Dr. Alfred Stengel: Dr. Norris has just expressed the thought that was in my mind, regarding the diastolic pressure to which Dr. Hare referred in the beginning, but which he did not, as I followed the paper, fully describe. If the theory of Hill was correct, namely, that the condition of resistance in the vessels of the lower extremities was accountable for the higher pressure in the leg than in the arm, then the diastolic pressure, never particularly high, would give evidence of this factor, for the diastolic pressure more than the systolic does indicate peripheral resistance. With Dr. Riesman it occurred to me that an ordinary cuff is not satisfactory for taking the pressure in the leg.

Dr. Hare's paper brings up the interesting question too often ignored in studies of cardiac disease, namely, that of the peripheral factor. The high blood pressure found in mitral stenosis shows the influence of the peripheral vessels in maintaining pressure.

Some time ago I had a patient under my care who at the same time was treated by a dermatologist for an eczematous condition of the lower extremity. The leg was dressed with a rather tight bandage, and the faintness and vertigo from which the patient had previously suffered were immediately relieved. This is another illustration of the influence of the peripheral element in circulation. In aortic regurgitation, undoubtedly Dr. Riesman is correct, that the throwing out of a large column of blood is the potent factor in raising systolic pressure. Again, we see in most of the discussions of this particular lesion the fallacy of looking at cardiac affections only centrally. The old idea that regurgitation of the blood is the whole cause of the collapsing pulse is quite erroneous. The main cause is the dilatation of the peripheral vessels. Hill's contribution is mainly interesting, as I view it, because it calls attention to the necessity of studying the conditions in the peripheral circulation more than has been customary in cases of valvular or other cardiac diseases.

Dr. Joseph Sailer: I had the privilege of seeing, some months ago, some experiments made by Dr. Janeway, which, if they prove to be correct, will throw some light upon this question. Dr. Janeway, by means of an apparatus too complicated to describe, was apparently able to show, although the demonstrations were not absolutely conclusive, that a wave passing through a vessel had a penetrating force greater than the highest point reached by the wave. If the theory upon which he is working is correct, it is easy to see how we

may have recorded blood pressures in aortic insufficiency which are higher than the actual pressure in the artery. The ordinary principles of hydrostatics should hold good in the human circulation as in water pipes, and there is always the tendency in water pipes for the water to seek a common level of pressure; therefore, I believe that this observation requires confirmation before we accept it unreservedly.

Dr. Hare, closing: My recollection is that between thirty and forty cases of various diseases, not aortic regurgitation, were tested, and it was found invariably that there was no marked difference between the arm and the leg. The observations as to the pressure in aortic regurgitation seemed so extraordinary that for a long time I was fearful of having made some error. Whether this high pressure in the leg is due to the size of the wave driven out of the heart or the force with which that wave is driven out, or whether it is due to contraction or spasm of the vessels of the lower extremity, I do not know, but it is probable that it is the latter, because if it were due to the central organ, wrapping the legs in hot wet blankets or immersing the feet in hot water would not lower the pressure in the leg and permit the pressure of the arm to be about the same as before. I think, further, that the administration of nitrite of amyl or nitroglycerin would not act if the cause was cardiac. The result of wrapping the limbs in hot wet blankets shows that there must be some local spasm in the vessels of the legs.

There are a number of observations which would seem to show that there is practically as much difference in the diastolic pressure in the leg and arm as in the systolic pressure of the leg and arm. I do not think much will be gained by the use of different size cuffs. I did not make a large number of experiments using varying sizes of cuffs, although they did vary in size. This is not, however, essential, as the cuff is not always placed about the calf. I don't agree that the vessels of the leg are so much larger than those of the arm. It is quite true that the popliteal may be larger than the brachial, but in the leg the posterior tibia and the tibialis anticus are smaller than the radial. I agree with Dr. Stengel that we are too prone to forget the influence of the vascular system. We know also the great importance of the splanchnic area. Some reflex influence here may cause the fall of blood pressure.

THE GROSS PATHOLOGY OF THE HEART[1]

WITH SPECIAL REFERENCE TO SCLEROSIS OF THE MITRAL VALVE

By ROBERT N. WILLSON, M.D.

In the brief time allotted to me there will be little opportunity for more than the bare presentation upon the screen of a series of

Fig. 1.—Sclerosis and atheroma of left auricular wall and of mitral valve. No involvement of aortic valve.

beautiful photographs, illustrating the gross lesions of the valve leaflets, the auricular and ventricular cavities and endocardium,

[1] Read June 1, 1910.

FIG. 2.—High-grade sclerosis and calcification of the mitral valve with excessive hypertrophy of left ventricular wall. Practically no involvement of the aortic valve.

FIG. 3.—Buttonhole mitral valve. Deformity due to sclerosis; aortic valve normal.

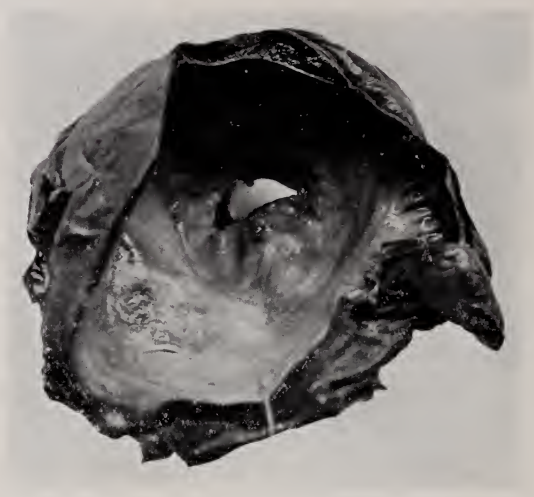


Fig. 4.—Sclerosis and atheroma of left auricle and of mitral valve. Aortic valve shows no pathological change.

Fig. 5.—Normal lungs and heart, showing the frequent covering of the heart by the lungs.

and the musculature of the heart. The slides are simply a few chosen from a collection made during the past ten years from autopsy material studied by me in private and hospital work, and also from gross specimens studied mainly in the Philadelphia General Hospital.

It will be noticed that I have endeavored to show both in the case of the muscular and valvular lesions a sequential progression from early and slight pathological change to lesions of higher grade but of similar kind. Also, that I have tried to emphasize the sequence of muscular changes upon valvular lesions, and of valvular insufficiencies upon muscular disease or fatigue. Finally, and with special interest, I have shown a series of cardiac views demonstrating the frequency of mitral sclerosis preponderating over, and oftentimes in the entire absence of sclerosis of the aortic valve or even of the aorta. As the latter findings are in direct opposition to the customary teaching, and yet are so plainly of not infrequent occurrence, I shall reserve comment upon their etiology and physiology until a later date. The series of fifty slides speaks for itself more eloquently and more practically than any words of mine.[1]

DISCUSSION

Dr. William E. Hughes: I was greatly surprised by the manner in which these heart lesions can be demonstrated by the lantern slides. I did not think it possible to make such excellent photographs and such absolutely accurate slides. While the pictures are most attractive they possibly do not demonstrate as accurately as can be determined by ocular demonstration the nature of the cardiac lesion. The sclerosis of the mitral valve is something that we see constantly in postmortem examinations and something that we possibly do not quite appreciate during our clinical studies. There is no question that the bulk of the mitral valves that come to autopsy are the mitral valves in a condition of sclerosis. Whether there is an actual sclerotic process throughout or whether the condition is the result of an acute endocarditis cannot be stated absolutely. There

[1] For obvious reasons it is impossible to reproduce more than a very few of these views, and as a consequence there are submitted here simply four illustrating the solitary sclerosis of the mitral valve, and one showing the very frequent normal covering by lung tissue of the entire heart, except the apex.

is no doubt that a large number of mitral lesions are essentially sclerotic. This must be borne in mind in prognosis in that a mitral valve lesion which can be demonstrated to be increasing in sclerosis is of much graver importance than a similar aortic valve lesion. If we get a mitral valve lesion commencing in later life we need not look back to an acute valvulitis. We may consider that it is sclerotic and that we have an unfortunate prognosis to deal with.

Dr. George W. Norris: It is quite astonishing, when one takes into consideration the fact that we have been studying cardiac disease ever since the time of Corvisart and Laennec, how much we have still to learn even in regard to the gross pathology. Thus, for example, it was demonstrated only a year ago by Fetterolf and Landis that cardiac hydrothorax is so often right-sided on account of pressure on the pulmonary veins, and not, as was previously taught, as the result of pressure on the vena azygos. Had he had time, Dr. Wilson would doubtless have emphasized the importance of venereal disease in the causation of cardiac lesions. A large number of cases of gonorrheal valvulitis, some of them fatal, have been reported. It has long been suspected that syphilis played an important role. The frequent association of aortic disease and tabes dorsalis had long been noted. Recently we have learned that a large number of cases of aortic insufficiency give a positive Wassermann reaction, and the treponema pallida has actually been demonstrated in the lesions. These findings are important not only from an etiological, but also from a therapeutic standpoint, since a positive Wassermann reaction indicates active syphilis, and calls for the continuance of, or the return to, antisyphilitic treatment. Another point which has recently been brought out is the insidious character of many cases of subacute endocarditis. Numerous individuals in whom an active endocarditis is going on are up and about, and not infrequently the slight degrees of irregular fever which occur in cases of supposedly chronic cases of valvular disease result from a progressive subacute endocarditis. A classification of the varieties of endocarditis is unsatisfactory whether we attempt to do so on a morphological, etiological, or prognostic basis.

A point which I think is often not sufficiently appreciated is the fact that calcification is Nature's method of repairing a weak spot in the arterial wall. The artery first undergoes fatty degeneration, and, rather than suffer a dilatation or rupture, calcium salts are deposited, even though it be at the expense of elasticity. This is well exemplified at the Philadelphia General Hospital, where many men with the most extreme degrees of arterial calcification often live to very advanced years, and die as the result of some intercurrent infection, whereas men whose arteries degenerate but do not calcify are apt to die much earlier in life from apoplexy, etc.

Another point which recent investigation has emphasized is the importance of the myocardium. The French have an adage that "disease of the valves

is not a disease of the heart;" which expresses this very aptly. We see this exemplified by the fact that most experimentally produced valvular lesions are unassociated with symptoms; edema is almost unknown, and if the animals do die, it is nearly always from infection. The left ventricle has been ligated at the junction of its lower and middle thirds and amputated, and yet the animal survived. The surgery of the human heart is another illustration. Some 160 cases of heart wounds have been operated on with a mortality of about 54 per cent. The suggestion made by Lauder Brunton some years ago that certain cases of mitral stenosis might at some future date be changed into a less serious insufficiency by means of the surgeon's knife no longer seems so very chimerical.

Dr. Willson, closing: As stated, I purposely omitted all reference to the etiology and physiology of cardiac lesions, in order not to overstep my time. Certain remarks that have been offered lead me, however, to say that even from the standpoint of the physiologist the outlook of cardiac study is not a hopeless, but a very hopeful, one. Moreover, with regard to my own attitude toward cardiac physiology, I would say that I am far from being a hopeless skeptic—that I am altogether a hopeful skeptic. My only fear is that we may be too hastily overconfident of early findings and fail to wait until there is obtained complete proof in place of that which seems to be simply indication. Thus, I am glad to endorse every advance that I have proved for myself or am convinced is proof of the newer physiology of the heart. The recent indications that there is a free nervous communication through the bundle of His, in the face of the positive teaching to the contrary only a few weeks ago, demonstrates our need of deliberation rather than haste in the formation of our cardiac conclusions. Further than this it is not yet permissible to go. An example of overzeal is to be had in the quotation of Dr. Fetterolf's claims regarding the cause of right-sided pleural effusion in cardiac disease. Dr. Fetterolf did not claim that pressure upon the pulmonary veins was the cause of all cases of right-sided effusion; merely that it furnished one of the causes. By way of proof that it is not the only cause is the occasional left-sided effusion, though the pulmonary veins on the left side appear in a position in which pressure from a dilated heart is far less likely, even though not impossible. I also intentionally omitted all comment upon the bearing of syphilis upon cardiac lesions, though I am daily more of the belief that this disease is directly responsible for many cases of cardiac disease. Both as the result of clinical and postmortem study, the conviction is fast taking root that syphilis ranks close beside rheumatism in its influence upon the valves of the heart, and not less so upon the coronary vessels and the cardiac musculature.

PRACTICAL TREATMENT—THE FUNDAMENTAL PRINCIPLES OF THERAPEUTICS[1]

ABSTRACT

By JOHN H. MUSSER, M.D., LL.D.

A STATE of absolute health must be considered as that condition in which there exists such perfect adaptation of the cells of the organism to their environment, individually and collectively, that a perfect correlation of their various functions results. Any disturbance of such equilibrium, and hence any departure from the normal in structure or function, is a state of disease. But disease, to the therapeutist, means not only this disturbance of equilibrium but includes, necessarily, the cause of the disturbance. While the causes which disturb the equilibrium of the organism are multiple, the effects, which are the reactions of the organism to the cause, are few in number. One can say confidently that these effects are uniform and occur in obedience to general biological laws. Hence, not only the intensity of the cause, but the state of the organism, determines the varying expressions of disease. The reaction is not a process requiring specific remedies for its treatment; it is a biological manifestation requiring biological methods for its guidance and control.

The environmental agencies which tend to cut life short or to excite disease and thus cause suffering are met by reactions in the organism which bring about an adjustment of the disturbed equilibrium. Such reaction is physiological, and is not a departure from that normal reaction which occurs between the

[1] Read June 1, 1910.

organism and its environment, save in the intensity of the process. By this reaction the organism protects itself—it expels, destroys, neutralizes, or antagonizes the agent.

Biology teaches the various modes of defense that living protoplasm, throughout all its variations, possesses. In the lower animals such mode of defense is a part of instinct, of "that inherent, unconscious intelligence—a faculty which is constant in its operation, and, though not inerrant, is free from the vacillations and failures of human reason" (Burroughs). It is well said that the lower animals are wise in order to survive and perpetuate species, but that outside of that sphere they are usually stupid. The high specialization of those senses by which the enemy can be deceived —the color, the form, the habitat, special secretions, the mode of storing food—are all biological methods of defense. Throughout the entire biological world these factors are operative. Thus, preservation of life is the inevitable result of natural law. In man, to the stimulus of instinct is added that of reason. However, when one sees the blundering attempts to aid preservation, notably in typhoid fever and other infections, one need not hold reason in such high esteem or feel complimented by the action of this higher attribute of man. If reason, however, is to be exonerated, then man is culpable.

As the essential attributes of life make for longevity, they become, when there is loss of equilibrium, as in disease, the strongest means the organism can possess for self-preservation. It follows, then, that the greatest defense the organism possesses is that correlation of cellular activities which is manifested in perfect health, and that that organism in which appropriation, assimilation, and elimination are perfect, and in which motion and sensation are highly developed, is the one in which life will be continued its usual period, and which has the best defenses against its enemy—disease.

Proper nutrition results in strength and resistance of the organism. Metabolism is attended by chemical processes which readily become active processes in the change of poisons—biological or inorganic—into innocuous materials, which processes aid in

maintaining the temperature of the body. An increase of this cellular activity brings about fever—a most important means of defense. The same nutritional and assimilative act causes an increase of the white cells of the blood—leukocytosis—another mode of defense of the organism. The increased nutritional processes stimulate secretory activity and thereby multiply the abundant resources of the organism, which are its "factors of safety," to be referred to later. In consequence thereof there arise to an increased degree the chemical processes which are essential in the defense of the organism. Insult of the nervous system causes pain, another mode of defense. Motor insults seen in muscle spasm, whether of voluntary or involuntary muscles, resulting in vomiting, diarrhea, cough, spasm of the ocular muscles, or other similar muscles; spasm and resistance of the skeletal muscles, are modes of defense—an exaggeration of the normal physiological acts.

It is of interest to inquire concerning the expression of the effect of the agents which either temporarily disable, often shorten, or completely destroy life. To rehearse the agencies themselves would be to enumerate all the etiological factors of disease and dwell upon all the environmental factors, a review not within the province of this discussion. The effects of such agents, inasmuch as they are physiological and uniform, can be briefly given. An understanding of the fundamental expressions of disease enables one to grasp readily the therapeutic requirements. These expressions are: (1) Morphological; (2) physiological; and (3) those of the reaction to infection.

* * * * * * * * * *

Diagnosis.—In this manner we can summarize the various affections against which the organism may have to defend itself. It can readily be seen that one might have begun with the infections and intoxications, proceeding in the reverse order, for they are often antecedent to physiological disturbances and to anatomical and functional conditions. So, also, the physiological conditions

tend to morphological and functional disorders. There is, therefore, very often a blending of the processes. It is common to see an infection cause a physiological disturbance which is followed by a morphological aberration. For instance, an acute thyroiditis will often cause hyperthyroidism, followed by a hypertrophy of the gland, with or without cyst formation.

If the therapeutist, therefore, asks himself the question, in each case with which he is confronted, is there an anatomical or a physiological expression of disease, or an infection, an infestation or an intoxication? and, if so, is it a primary or secondary condition? it will enable him to interpret clearly and to direct lines of treatment more effectually. The answer will bring at once to his mind the processes which nature has at her command for defense.

Before any attempt at interference other than "direct" treatment of the cause, an estimate must be made of the reparative power of the organism. This will mean, at once, an inquiry into the nutrition, and hence the resistance of the organism and its capacity for maintaining nutrition, the degree of elimination, and the health value of all the organs of the body.

The Defenses of the Organism.—What defenses and adaptive powers does the organism possess?

Nature defends itself against the various morphological disorders by (1) expelling a newgrowth or a foreign body; or (2) by surrounding the latter by inflammatory products, which render its presence innocuous; or (3) by overcoming obstruction by hypertrophy; or (4) by the formation of a collateral circulation. The efforts to remove calculi, the vomiting of undigested food, the discharge of foreign bodies from the intestinal canal by diarrhea, from the eye by a flood of tears, from the nose by sneezing, and from the throat and lungs by coughing, are defensive acts.

In functional disorders and fatigue conditions the methods unconsciously resorted to by the organism to bring about repair are rest or exercise, sunlight, fresh air, tonic environmental conditions, and the adaptation of duties to the actual powers of the organism, such as limiting a physiological act, like digestion, to its capacity.

The Infections.—The reaction of the organism to a local infection is seen in the process known as inflammation. The defensive reaction gives rise to an increased flow of blood to the part, an increase of the leukocytes, and later an increase of the fixed tissues. The increased amount of blood destroys the bacteria and neutralizes the toxins or the ferments; the leukocytes engulf the bacteria or, by their chemical functions, exercise an antitoxic or antifermentative influence; the new tissue walls off, and by mechanical or vital powers, destroys or removes the primary cause, and removes or dissolves necrotic tissue. Leukocytosis, from repeated observation, is a strong means of defense. As pointed out by Adami, it is a defense by adaptation. Fever is another agency of defense in the infections, whether local or general.

Clinical[1] and pathological evidence shows that fever, if not too high or too prolonged, enables the organism to resist pathological invasion, and that it attenuates the growth and virulence of many microörganisms. It is an attempt at autosterilization. The occurrence of leukocytosis and fever creates antitoxins, bacteriolysins, agglutinins, precipitins, and coagulins—new forces which develop the defense of the organism.

Fever or leukocytosis, the course of which is normal for the infection in question, may be looked upon as a healthful reaction of the organism.

The great defense of the organism against infection is the creation of immunity. When established by the organism it is known as active, when by the physician, as passive, immunity. A discussion of the principles underlying the production of immunity will be found elsewhere.

The infestions may be overcome naturally by the organism, either by expulsion, as in the vermes, or if established in the tissues, by a reactive inflammation which destroys or encapsulates the infestuous agent.

[1] The Uses of Fever; the Danger of Antipyretics. Musser, Medical News, 1892.

The Intoxications. They are endogenous and exogenous. The endogenous intoxications are rendered innocuous by the chemical correlations previously considered, by elimination, and by the vicarious action of organs. The product is neutralized, antagonized, or eliminated.

Thus far we are unfamiliar with specific defensive agencies against alcohol, tobacco, tea, coffee, and allied materials. The only suggestion of defense in these instances is that of toleration. The system tolerates for a time their action, but sooner or later tolerance ceases.

In what manner is the organism defended by perversions of metabolism or of internal secretion? The answer is best given in the words of Meltzer: the overwhelming abundance of structures provided to conduct a single function; the ability of the secretory organ to receive stimuli through chemical or nervous sources, so that one may supplant the other; the likelihood that one group of glands can assume the function of others or new cellular activity replace lost cellular activity elsewhere; the change in character of the products of cellular activity by the new agents, whereby the new excretions or ferments are neutralized or antagonized.

By this adaptability a spontaneous cure is brought about. Increased functioning or a modification in the functioning of other tissues may have an indirect favorable action on the elimination of diseased products. The indirect influence through the chemical action of one organ on other organs is the great defense of the organism in metabolic and secretory disorders. It is here that so-called indirect therapeutics must come into play: to secure healthful action of all the organs and tissues unaffected will modify or mitigate the effects of the diseased structure.

It is thus seen, in accordance with natural law, that the organism is supplied with powers of nutrition which induce resistance, which enable it to protect itself by the destruction, by the counteraction, and by the elimination of deleterious agents, and thus by adaptation provide for the reëstablishment of the disturbed equilibrium. It follows, as a scientific ultimatum, that it is the province and the

duty of the physician to conserve these forces of nature. Realizing the various properties of protoplasm, one is reminded of the statement of Bigelow: "It is required that the physician safely conduct the patient through disease into health." The physician does not drive out disease, as was believed to be his province in the past, but, rather, he drives in health.

We thus have a modern scientific basis for the familiar Hippocratic dictum "to do good or do no harm." To engage otherwise than in obedience to biological laws would be meddlesome and harmful. Unfortunately, nutritional, resistant, defensive, and adaptive powers may, for various reasons, not accomplish their purpose. The factors of safety may not be equal to the demands upon them. It is the function of the physician to determine the deficiencies and aberrations and to supply means to aid the organism.

Failure of Defense. Failure of the defenses of the organism against disease takes place because of the overwhelming action, quantitative or qualitative, of the causal agency. It may also be due to decreased resistance of the organism. Usually the defensive properties are sufficient, provided the organism is in perfect health. In such state, in response to the irritant, the normal forces of the organism are increased; they are distributed rapidly where needed; the reserve force is sufficient to meet the emergency, or an abundance of new forces is created. On the other hand, the organism may be handicapped by weakness, congenital or acquired, morphological or functional, by previous disease, by the period of life, or by the environmental conditions.

Aids to the Defenses. The offices of a physician are not specially required by the physiologically and anatomically normal man when he is sick. When, however, there is excess or diminution of the processes of preservation and adaptation; when there is modification of the processes of nutrition, as seen in the impaired metabolic states referred to, the physician's services are definitely needed. After the physician has determined (1) the cause of the affection from which the patient suffers, (2) carefully estimated the morbid processes and the manner and stage of the reactions

of the organisms, (3) determined the health value of all the organs and systems of the organism, (4) estimated the degree of suffering, and (5) gathered the facts of the family and racial history and of the personal or social history, including the previous medical history—in short, studied the individual—he can plan a procedure to relieve suffering and facilitate recovery.

Mode of Aid. It is needless to say that in many cases a judicious *expectancy* is all that is required, and, bearing in mind nature's defenses, it is usually the wise plan to follow.

Treatment may be *direct* or *indirect.*

Direct treatment aims at the cause of the disease, *etiological* treatment, or at the symptoms of the disease, *symptomatic* treatment.

Symptomatic treatment is a phase of humane treatment. All treatment is humane, but when directed specifically to relieve suffering, it is especially deserving of the appellation.

Treatment may be *indirect.* If it is not possible to treat the cause, an *indirect* therapy is adopted, a method referred to in the previous pages. The individual is the object of treatment.

Indirect treatment is conducted by methods which are *physiological* and by methods that are *pathological.*

Physiological therapeutics embraces the use of all procedures which sustain life and make for health in the normal organism. The effort is made to stimulate physiological processes, to repress them when in excess, to direct them into proper channels. It implies the management of the normal forces of the body.

Pathological therapeutics aim to imitate nature in the creation or direction in proper channels of new forces. It assists in the formation of new defenses or supplements the normal defenses. Hence we have serum therapy.

The defenses or methods of repair are (*a*) assisted by employing similar methods, and (*b*) restrained or modified when they are in excess. How may we aid the defenses of the organism?

The defenses of the organism may be deficient; they may be excessive; or they may be brought into action irregularly or without that harmony of action of all the organs of the body which is neces-

sary for its highest physiological action. They require the assistance of man. Hence, as Cabot well says, we must attempt (*a*) to supplement or imitate nature's efforts; (*b*) to oppose or neutralize nature's efforts; (*c*) to modify, limit, or divert nature's efforts.

It will occur to anyone reviewing the functional disorders that following the lead of nature we can aid the defenses of the organism in many, if not all, of the affections which belong to this group.

We aid nature in its defenses against the anatomical expressions of disease by regulating the entire life of the organism so as to bring about adjustment of function or complete adaptation. The aid of the surgeon is required in these anatomical conditions more frequently than in any other—to remove calculi the organism cannot expel, and tumors that are not encapsulated or free from anatomical disturbance; to repair excesses or misplacements of adaptive processes, as the removal of adhesions

The inflammations are aided by the removal of the cause, as bacteria or a foreign body, or of the products, as pus or a gangrenous appendix; by poultices or passive hyperemia to increase the inflammatory edema, in the serum of which ferments, to destroy bacteria and antibodies to neutralize toxins, are present; restrained by position, by cold, and by sedative applications, if pain and other symptoms are deleterious to the organism. Nature is also aided by an increase of leukocytes and by encouraging or repressing fever.

Immunity is active and passive. The former is stimulated by injecting killed organisms into the infected subject. The attempt is made to stimulate the powers of the body to greater activity in the production of immunity. Hence, vaccination is conducted with success in typhoid fever, especially in preventing relapses; in plague, in cholera, and in local streptococcic, staphylococcic, and Bacillus coli communis infections. Passive immunity, in which field the great triumphs of serum therapy have been made, is conducted in diphtheria, tetanus, and cerebrospinal meningitis by the injection of the respective antitoxin.

On the other hand, some of the defensive reactions of the organism, as fever, must be controlled, if excessive and harmful. There

is evidence that in those infections in which the toxin is liberated from dead bacteria this liberation is increased, and hence the toxemia is increased, by higher temperature. Anything which lessens the toxic production will lessen the toxemia; hence, we see the beneficial effects of cold baths in typhoid fever and of quinine judiciously administered, as pointed out by Richardson.

It is thus seen that the physician is a biologist, and that the best results must come from the employment of biological methods in the study of his case. It is necessary not only to determine the degree of suffering and the cause of the suffering, but to note the effects of the disease upon the individual. The careful weighing of the reactions of the organism, of the power of its defense, and the ability for adaptation is essential. To do this and then assist nature where there are deficiencies, to control or neutralize when there are excesses, must be his endeavor.

The bountiful resources which the therapeutist has at his command, and the indications for their use, should be familiar to him. It is scarcely to be expected that the practical application of all of them could be conducted by one individual. He would be debarred because of lack of time or because of the inability to acquire the technique of the various methods. The rigorous scientific methods required demand a technique elaborate and painstaking. It follows that, as we advance in our onslaught on disease, specialists in therapeutics will arise, if they have not already arisen. Inasmuch as prevention goes hand in hand with diagnosis and treatment, a large group of the infectious diseases will fall to the care of the State, in great part at least. With trained technicians in the application of therapeutic measures, as, for example, the surgeons, suffering mankind will receive a corresponding benefit. Just as we now see the internist and the surgeon in coördination, so we will see the internist aided by the specialist in involved technique in therapeutics. The control and stimulation which we see in the first instance will attend the second.

It goes without saying that the essential of success in therapeutics is correct interpretation. The attempt to diagnosticate the ailment correctly is of itself a therapeutic measure. If properly conducted,

it indicates to the patient interest on the part of the physician, which arouses hope, and it gives evidence of skill which stimulates confidence. To secure these psychic stimulants of the physiological processes of the patient is to attain a most, if not the most, helpful force in restoring health.

Medicine is a science and an art. The recognition of the cause of disease by instruments of precision and by biological methods is a science; the interpretation of the effects of the disease is a science and an art. The organism is often unwilling to unfold its processes. It is secretive of the effects of disease. This is especially true of psychic conditions. To extract the secrets, to unfold the mysteries of the various reactions of the organism, requires an art which is in part inherent, as tact is inborn, yet which is in greater part the result of long experience. When the older practitioners fought their battles single-handed, without biological aids, this power of interpretation and treatment was an art, the possession of which today should not be disdained. While the possibilities of therapeutics are immensely enhanced by the science of medicine, they have lost something by the tendency to disregard the art of medicine.

DISCUSSION.

Dr. J. C. Wilson: The subject which was presented in a philosophical spirit is one that cannot be given the discussion it should have in the brief time permitted. The paper was full of suggestions in regard to therapeutic measures which are well worth considering. We, I think, too often in the merely concrete, specific drug or method, forget the underlying, justifiable, and significant relations of our therapeutic management, and a paper of this sort is most timely.

THE REPORT OF A CASE OF BLOOD DYSCRASIA FOLLOWING CALOMEL[1]

By WALTER G. ELMER, M.D.

In a study of the case here presented there appear to be certain features of unusual interest and which are not altogether easy of explanation.

The patient was severely, almost fatally, poisoned after taking calomel, and there seems to be good reason to believe that an actual blood destruction took place. I will give a brief outline of the history of the case, and then give the reasons for reaching this conclusion.

The illness in question occurred one year ago in May. The patient is a man in middle life, married, strong and muscular in build, of medium height, normal weight, and by occupation a college professor. He has enjoyed good health except for occasional functional disturbances. In 1904 he was troubled with flatulence after eating, and about three hours after a meal experienced a sense of pain and emptiness in the region of the stomach and a craving for food. These symptoms disappeared on taking food. Physical examination showed the stomach to be normal in size and position, and no well-defined area of tenderness could be made out. There was no nausea at any time—occasional headache. The diagnosis was hyperchlorhydria. Nitrate of silver and hyoscyamus one-half hour before meals and bismuth salicylate two hours after meals gave relief and was continued for two weeks. The patient continued well for a long time, but in 1906 he again had symptoms very similar to those given above, which disappeared in about ten days. In February, 1909, another period of hyperacidity was promptly relieved by treatment.

[1] Read June 1, 1910.

The patient continued well from that time on until May 5 which was the beginning of his serious illness.

On that day he did not feel well, but had no definite symptoms. He thought he needed calomel, and took a tablet triturate of calomel and soda every half-hour until he had taken eleven doses. He thought he was taking $\frac{1}{10}$ grain doses. He slept well that night, but the next morning, after having a very small formed movement, he felt that the calomel had not acted well, and took two teaspoonfuls of magnesium sulphate to eliminate it. He felt badly all day, and I was asked to see him. I attached no special importance to his condition—told him the calomel had been the only medicine he required, and advised another dose of the Espom salt at night. That evening there was a small clay-colored movement. The next day, Friday, he went to the circus with his little daughter, and on the way home on a crowded car he felt so weak and dizzy that he bribed a small boy to give him his seat. He had no pain at any time. In the night he vomited about a teacupful of very dark material, evidently decomposed blood, and was troubled with dizziness on raising his head, and with rapid heart action.

Saturday morning there was a small, black, tarry stool, evidently also decomposed blood. The patient had moderate fever, about 100°, pulse slightly above 100, and a very soft systolic murmur heard at the apex and over the base of the heart.

I asked to see the bottle which had contained the calomel tablets, and discovered that the patient had taken 1 grain tablets instead of $\frac{1}{10}$ grain, having taken eleven grains in all in divided doses.

There was no pain and no tenderness in the region of the stomach or right hypochondriac area. There was nothign in the patient's color that especially attracted my attention other than the fact that he appeared a little pale and seemed quite sick. I advised the use of the magnesium sulphate as before, a liquid diet, ample amount of water, and absolute rest in bed. About midnight the patient again had the rapid heart action and feeling of weakness. I suggested an ice bag over the heart.

On Sunday the heart murmur had become so pronounced and the heart muscle so relaxed that I strongly suspected a septic endocarditis. The temperature ranged between 100° and 101° and the

pulse from 110 to 120. The general weakness was so noticeable that I asked the patient not to try to raise himself up from the pillow, and ordered small doses of digitalis.

There had been but one black, tarry movement—as has been mentioned—and the subsequent movements once each day contained evidences of old decomposed blood, but soon returned to the usual color, and there was no further evidence of renewed bleeding.

The following day, Monday, I was at once struck by the patient's pallor. The heart murmur had increased, the temperature and pulse continued about the same, as well as the general weakness. I still felt there was an ulcerative endocarditis, but from the entire absence of pain I was much in doubt about it. I ordered Basham's mixture three times a day, and decided to make a hemoglobin estimation at my next visit.

On that day, Tuesday, the patient was absolutely colorless, the hands were waxy and translucent to light, the lips and conjunctivæ white—there was, in fact, not the faintest trace of color about him. He himself remarked upon the peculiar waxy and translucent appearance of his hands as he held them up to the light. The heart murmur was, if anything, even more definite; the temperature, pulse, and weakness about the same.

The von Fleischl instrument registered the hemoglobin at 20 per cent.

I ordered potassium iodide in five-drop doses three times a day. The treatment, therefore, consisted of salts in the morning and an enema when necessary, Basham's mixture and digitalis three times a day, and in the interval potassium iodide three times a day.

In order to eliminate the possibility of a preëxisting serious blood disease, I asked for a differential count of the leukocytes, and this was made the next day. The hemoglobin was then 19 per cent. by the Dare instrument; the red cells, 1,252,000; white cells, 5200; large mononuclear cells, 4.1 per cent.; small mononuclear cells, 28.5 per cent.; neutrophiles, 63.4 per cent.; eosinophiles, 1 per cent.; basophiles, 1 per cent.; neutrophilic myelocytes, 2 per cent.; numerous macrocytes and a few nucleated red cells.

The urine remained clear, specific gravity about 1016, no albumin and no casts.

The next day, May 14, the hemoglobin was 22 per cent., and on the 16th it had reached 30 per cent.

From that time on the patient's color began gradually returning; the temperature and rapid pulse slowly subsided.

On May 18 the hemoglobin was 38 per cent.; red cells, 1,584,000; pulse, 76. May 22, hemoglobin, 53 per cent.; red cells, 2,612,000; heart murmurs very faint; patient up and dressed. June 1, hemoglobin, 67 per cent.; red cells, 3,372,000; heart about normal.

June 2 he left the city for the summer, feeling well. Continued to improve in health and strength at the seashore, and has remained perfectly well ever since; and this winter passed a rigid life insurance examination.

It seems to me from my personal knowledge of this patient, which extends over a period of seven years, that it is exceedingly unlikely that he suffered from either a gastric or duodenal ulcer, for there has never been any definite area of pain or tenderness which might be caused by an ulcer—and for months, or even a year or two, at a time he had no symptoms of any kind, and he has been entirely free from symptoms since his illness. We can almost certainly dismiss gastric ulcer. Duodenal ulcer must receive more careful consideration, for the symptoms which he presented on several occasions, and which I have ascribed to hyperacidity, might have been caused by a duodenal ulcer.

Hyperchlorhydria may be a purely functional condition, and when it is, it is usually very quickly relieved by treatment. The symptoms usually disappear if an alkali is given or food is taken, and even a glass of milk or of water will give the patient prompt relief. Treatment which will inhibit the undue activity of the gastric glands or partially neutralize their secretion will act in a similar manner. If the symptoms are due to organic disease they are apt to be more intractable and very prone to return. This patient apparently had at times a marked hyperacidity, which in each instance yielded promptly to treatment.

Had he taken the eleven grains of calomel at a single dose, it is probable that it would have acted as a prompt purge and caused no bad effects. Taken in divided doses—a grain at a time—it is possible that the mild chloride was acted upon either by the gastric or intestinal juices and a small portion of each dose was

converted into the corrosive chloride of mercury and absorbed; and it was the cumulative effects of these repeated small doses which resulted in the blood dyscrasia.

Mercurous chloride is an unstable compound. It may change to mercuric chloride in an acid medium or in an alkaline one. Even in a solution of common table salt, sodium chloride, the conversion may take place. One of the theories in regard to the absorption of calomel is that it is converted into a double salt of mercury—the albuminate of mercury and mercuric chloride—and in this form it circulates in the blood. Fatal poisoning has followed a medicinal dose of nitrohydrochloric acid while a patient was taking calomel, the calomel having been converted into corrosive sublimate in the stomach in sufficient quantity to cause death.

It will be noted in the case here reported there was no purging. The drug was absorbed and there was no effort on the part of nature to eliminate it.

The hemorrhage which occurred into the stomach or duodenum, or both, must have been small in amount, and may have been a direct transudation of blood through the mucous membrane, or may have been due to a dissolution of the walls of the capillary vessels themselves from the action of the poison. The actual loss of blood itself was scarcely sufficient to cause so extreme an anemia. A man in normal health and vigor, showing no sign of weakness or of pallor, could scarcely have his blood depleted in a few days to the critical point reached in this case without the loss of very large quantities of blood, if the anemia were due to hemorrhage alone. There must of necessity be the daily vomiting of large quantities of blood, or it must be passed in large amounts by the bowel, even bright red blood appearing in the movements. Even granting that a patient might partially digest and absorb some of his own blood on its passage through the bowel, nevertheless the amount passed must be large if in so short a time his red cells are to be reduced to 1,200,000 and the hemoglobin to 19 per cent. A single large hemorrhage which would deplete the blood to this extent must necessarily send the patient into collapse. None of these phenomena occurred in my patient. Then, too, the pallor of the patient increased from day to day and the heart murmur

increased in intensity long after all traces of hemorrhage had ceased.

These are the reasons which, after careful consideration, have led me to exclude duodenal ulcer in this case.

A patient in the Montreal General Hospital vomited 10 pounds of blood by actual measurement in seven days. Under such circumstances the most extreme anemia must, of course, follow.

The fact that the urine remained clear does not help us very much in reaching our conclusions, for we know that blood destruction can occur without hemoglobinuria, as is seen in some cases of snake-bite. The venom of the cobra, for example, may cause very great blood destruction without any noticeable changes occurring in the urine. So long as the liver is able to handle the hemoglobin it need not necessarily appear in the urine. The liver cells quickly abstract the hemoglobin, which has been liberated from the blood cells, from the blood plasma and send it down through the hepatic ducts and common bile duct into the intestine, and so it leaves the body. The spleen also may have some part in the abstraction of the hemoglobin from the blood stream.

The conclusions which I have reached, therefore, in regard to this patient's illness are these:

A patient with a marked idiosyncrasy to mercury took calomel when he was feeling unwell in a very unusual dose. The gastric and intestinal secretions were not in the usual condition of a person in normal health. The drug was not eliminated, but remained in the circulation or tissue cells and resulted in a profound blood dyscrasia. There were no marked evidences of salivation. I have purposely deferred reporting this case for one year in order to notice any subsequent symptoms which the patient might present. He has had no symptoms whatever, and has remained in the best of health.

There is a case of mercurial poisoning which has not been recorded and which seems to have some bearing upon my patient's illness. It is that of a woman who, after a single douche of bichloride of mercury solution in the strength of 1 to 5000, developed the symptoms of corrosive chloride poisoning similar to cases already reported. However, after all traces of hemorrhage from the mucous membranes had ceased, the red cells and hemoglobin

continued to fall progressively day after day, in spite of all treatment, until they finally reached 1,200,000 red cells, hemoglobin, 17 per cent., at which point the patient expired.

In my case the red cells reached 1,252,000 and the hemoglobin 19 per cent., but just here the tide fortunately turned and he made a good recovery.

DISCUSSION

Dr. Hobart A. Hare: I think the idea that the calomel is converted into corrosive chloride of mercury is not generally accepted at this present time. The whole subject of what happens to the calomel is rather nebulous. The dosage was not sufficient, I think, to produce a physiological effect. I did not hear Dr. Elmer speak of any disorder of the salivary glands, or whether there were any signs of gastro-intestinal irritation produced in this case.

Dr. Elmer, closing: In regard to Dr. Hare's question upon the conversion of the calomel into the corrosive chloride, it is difficult to say how the change is made. Mercurous chloride can be changed into mercuric chloride in an acid medium; also in an alkaline medium. A solution of ordinary salt may cause this change. Whether such a conversion occurred to any extent in this case is mere conjecture, but there seems to be very little doubt that this patient's illness was caused by the mercury which he took. The kidneys continued to act well without any trace of albumin or casts.

THE INDUCTION OF PANCREATIC ACTIVITY BY THE REMOVAL OF THE ADRENALS[1]

By RALPH PEMBERTON, M.D., and J. E. SWEET, M.D.

(From the Woodward Fellowship, Pepper Laboratory of Clinical Medicine, University of Pennsylvania, and the S. Weir Mitchell Laboratory of Physiology)

We reported before the Association of American Physicians in Washington, May, 1909,[2] the results of our work on the relation of certain ductless glands to the pancreas, and we there offered, among other conclusions, the following:

1. The inhibition of pancreatic secretion by adrenalin is independent of systemic blood pressure, as shown by its persistence when the blood pressure is much below normal and by other evidence.

2. The inhibition by extracts of pituitary and suprarenal bodies also occurs when the pancreas is stimulated by its normal excitant, HCl in the duodenum.

3. The evidence now at hand indicates that the suprarenal glands exercise an inhibitory power upon the pancreas, and that on the removal of this influence by ablation the pancreas secretes more actively.

4. The agonal period of life (in the sense described) is generally accompanied by an exacerbation of the normal rate of pancreatic flow.

Our report was preliminary, and although our conclusions were strongly suggested by the evidence at our command, they were

[1] Read June 1, 1910.

[2] R. Pemberton and J. E. Sweet, Further Studies on the Influence of the Ductless Glands on the Pancreas, Trans. Assoc. Amer. Phys., 1909, xxiv, 502.

not supported by that number and variety of experiments which alone could offer substantial proof.

In order to ascertain the truth, and definitely to corroborate or disprove our conclusions, we have devoted the past year to a repetition and amplification of our earlier work, together with certain changes in its terms, on such a scale as would place the results to be obtained by these methods beyond reasonable doubt. The results so obtained we wish now to report.

PRIOR WORK

For three years past we have been concerned with the question of pancreatic activity in several of its phases, and have shown that extracts of the adrenal and pituitary glands, when injected into the system, cause a diminution or cessation of the flow of juice from the pancreas, whether this flow be caused by the normal chyme, hydrochloric acid artificially placed in the duodenum, or duodenal secretin intravenously injected. We have obtained this result from no other tissues as yet, though many have been tested; but certain extraneous agents, among them nicotine, are reported to have an analagous action.

The modus operandi of this phenomenon is still *sub judice*, though it has been attributed to vasoconstriction. Some evidence supports this, not conclusively as yet, but the observations here to be presented seem to throw further light on the matter.

Other relations between the pancreas and the ductless glands of the body we have elsewhere taken up and need not now consider; but the connection just mentioned between the pancreas, on the one hand, and the adrenals and the pituitary, on the other, concerns us especially.

PRESENT PROBLEM

If the intravenous injections of extracts of the suprarenal and pituitary bodies cause inhibition of the pancreatic flow, after whatever method of excitement, the question is at once presented as

to what would be the effect of removing from the pancreas such influence as these glands normally presumably exert. Evidence on this latter point would not only be of interest in enlarging our present conceptions of interglandular action, but would also tend to act as a check on the former observation and possibly help elucidate the mode of action.

As we have elsewhere pointed out, the difficulties to be met in such a problem are very great, and necessitate the utmost care in the interpretation of resuls as well as in obtaining them. The terms of a biological experiment are rarely exact, and in this particular instance we have to deal with many factors that are indefinite and poorly understood. In addition to this, the time required for a single experiment in some instances has been so great as to preclude its frequent repetition; such experiments requiring the practically undivided attention of two observers over periods of seventeen or eighteen consecutive hours.

METHODS OF WORK

Our method was as follows: We established in fasting dogs a temporary pancreatic fistula by introducing into the pancreatic duct a cannula through which the flow of juice could be observed and measured. This flow was recorded by interruptions of the base line on a kymographion tracing as the juice passed divisions on the cannula. Records are preserved in the form of continuous tracings of each experiment, from the beginning of anesthesia until death.

Coincident tracings were made of the respiratory movements, blood pressure, and the time in seconds. The details of our work hardly call for explanation here, as they are fully set forth in our previous contributions on this topic.[1]

[1] J. E. Sweet and R. Pemberton, Experimental Observations on Secretin, with Special Reference to Diabetes and Malnutrition, the Archives of Int. Med., 1908, i, 231; The Inhibition of Pancreatic Activity by Extracts of the Suprarenal and Pituitary Bodies, Ibid., 1908, i, 628; 1908, ii, 295; Further Studies on the Influence of the Ductless Glands on the Pancreas, Ibid., 1910, v, 466.

Our animals were under complete surgical anesthesia by ether from the beginning of the experiment until the end.

Following the establishment of the above procedures, the adrenals were removed through a large median incision, which also served for the pancreatic manipulations. The adrenals were removed by blunt dissection, the right usually first, since it is less accessible and operation on it produces a greater disturbance to the general economy than is the case with the left gland.

Sometimes the order of procedure varied from that just given, though we usually found the latter the most expedient. Animals which have been subjected to bilateral ablation of the adrenals withstand poorly any further trauma, even that of establishing a connection with the respiratory tambour or blood pressure manometer, and not infrequently succumb prematurely.

The total number of our experiments was forty-one, exclusive of a number devoted to certain incidental features which will be mentioned later. This does not include those observations on which we made our first tentative report.

Our object was to observe the normal rate of pancreatic secretion under the conditions of a temporary fistula, and then to observe the rate after the removal of the adrenals. In our work of a year ago we had not realized sufficiently the importance of using only fasting dogs, and, as a consequence, the question became complicated by the presence of a flow from the pancreas from digestive causes. We know now that the phenomena to be considered are not essentially altered under these circumstances, and are indeed rendered very graphic and striking; but the interpretation of results is made much more difficult by this complication.

In the experiments now discussed the dogs were, therefore, animals which had been fasted for thirty-six hours, and, except for one or two which had broken loose and had foraged, unknown to us until later, the gastro-intestinal tract was free from food. The experimental and control animals were selected to conform in size as nearly as possible, and were often of the same breed.

FINDINGS IN NORMAL DOGS

In normal dogs under ether there is a slight tendency, even during a fast, for the pancreas to secrete. This may be inconspicuous for hours at a time or even apparently absent, but, sooner or later, it generally shows itself, so that toward the end of a period of observation there is usually a well-marked, though relatively slight, flow. This may, however, be more pronounced throughout, and some dogs, for reasons which we do not understand, may secrete with fair activity. Each dog forms more or less of a law unto itself, and, if the flow is sluggish at the start, it never becomes rapid or prolonged later. Within the terminal or agonal moments it often undergoes a distinct exacerbation. The total amount of flow in normal animals may therefore vary between a practically unmeasurable quantity and seven to nine cannulafuls in the course of ten to seventeen hours.

If, as often occurs on introducing a cannula into an organ so vascular as the pancreas, there be a slight hemorrhage and the clear juice become clouded by blood, doubt at once arises as to whether the duct is clear; and, if the flow be sluggish, the condition simulates obstruction so perfectly that only the course of events, or autopsy, after perhaps sixteen or eighteen hours, will show the truth. We know no way of obviating this, as the cannula cannot be removed frequently from such delicate structures. If, however, the duct be clear, the meniscus of juice in the tube moves with the movements of respiration and affords a fairly reliable index of patulency. The evidences of flow when the duct is first opened are also of value as indicating what may probably be expected from the gland. Also, if there be obstruction, and secretion be free, the gland may appear somewhat edematous.

In normal dogs the blood pressure is but little affected by the operative proceedings described, and it falls only after prolonged etherization or as the strength of the animal fails. This may be after a variable period which sometimes much exceeds seventeen hours, the only condition to determine death being, apparently,

the relation of the amount of ether to the animal. In other words, if the ether is carefully watched, the dog will live for a long period; but, if the ether is carefully pushed, the end can be materially hastened.

In those subjects which have survived so long we have often given more ether until the blood pressure slowly fell, since otherwise the observations would have been essentially on normal dogs under conditions which would not serve as controls for the phenomena we wished to examine.

FINDINGS AFTER REMOVAL OF THE ADRENALS

On the other hand, in contrast to the results with normal animals, if the adrenals be removed, the picture becomes very different. The operation of ablation itself produces considerable shock, and when after some oscillation the blood pressure becomes steady, it is generally found to be significantly lower. This does not seem to be due to the operative disturbance alone.

The right adrenal, as remarked, is difficult to remove, but the left can be taken out with relative ease in a few minutes. Now, if the right alone be removed, the shock of ablation *per se* is very marked, but is not greatly increased if the left be also removed, and animals so treated have lived almost as long as the normal under ether, that is, ten to fifteen hours. When both adrenals are removed the pressure never returns to a height approximating its former level, but suggests the condition seen after many hours in the normal animals. It declines more or less rapidly until the animal dies after a variable period, say six to eight hours. During this period, in every instance encountered so far, the pancreas begins shortly to secrete, and increases in the rapidity of output until in some cases this secretion is so great as to make a record of it difficult, except in terms of five divisions of the cannula as units. The number of cannulas filled is consequently vastly in excess of those seen with normal dogs, and indicates a proportionately greater formation of pancreatic juice.

There is no definite time of the experiment or condition of blood pressure at which the flow begins, as the factors which regulate the flow seem to depend, for the most part, on the idiosyncrasies of the dog; but, in general, it can be said that it begins in not less than two hours or more than five.

It can be seen, therefore, that no dependable statistical average can be made of the rate or quantity of flow, or of the other contributory factors under which it takes place; but this much seems definitely sure, that, after removal of the adrenals, there always occurs a flow, and that this flow may reach such proportions that we are unable to duplicate it, save by the injection of powerfully active duodenal secretion.

Indeed, if the animal has not fasted, ablation of the suprarenals induces such activity that even the results sometimes obtained from the last-mentioned stimulus may be exceeded. The contrast between normal control animals and those without their adrenals is, therefore, very marked.

It is important to note that this flow begins earlier, that it lasts very much longer, and that it is greater in volume and rate, or both, than the normal output, despite the fact that death occurs much sooner. Once established, however, the duration of the flow is limited, apparently, only by the life of the animal. The longer the animal lives, the longer secretion takes place.

These facts must be borne in mind in comparing, for example, a dog with adrenals ablated, whose pancreatic flow is sluggish at the start, with a normal dog whose pancreatic flow is active at the start; and especially is this true if the normal dog lives long and secretes a number of cannulafuls during, perhaps, sixteen hours, while the ablated dog shows an early exacerbation, perhaps, but also early death, before the total output is very great.

While there is nearly always some little flow from the normal animal, however, it rarely passes a point which we have grown to regard as the usual limit under such circumstances, namely, about six to eight cannulafuls in a period of possibly as much as seventeen hours.

More frequently, however, there is almost no flow at all, save

at the end, when there supervenes a condition which simulates in some respects that induced earlier by the removal of the adrenals. There seems to be an analogy between these two conditions; and the normal dog may conceivably reach a state in which his system as a whole presents apparently the same need of suprarenal activity as does the animal with adrenals ablated. Whether this is the case, however, is, as yet, purely conjectural.

There is here, however, one point of interest, which seems to us to throw light on the modus operandi of the feature under discussion. As has been said, the inhibitory action of epinephrin[1] has been ascribed[2] to its vasoconstrictive power. This may be justifiable, though, as we have elsewhere stated, some evidence opposes it. If the flow from the pancreas be inhibited by vasoconstriction and a high blood pressure, it would seem that the opposite condition of affairs would be conducive to a flow. We know that a low blood pressure alone will not lead to this. If, however, on removing the adrenals we find a marked tendency to secretion, at the same time that the blood pressure is low or falling, we naturally incline to associate the events, and to regard one as perhaps causative of the other. We have here, though, evidence that this is not the case, because if a normal dog be watched, as described, the blood pressure will be found to fall just as low as it does with the dogs whose adrenals have been ablated and remain low just as long, or perhaps longer, but no flow occurs, or at most one which is manifestly inferior.

The problem is not settled by this observation, but the latter strongly suggests that the relation of the adrenals to the pancreas is very close. Taken in connection with the inhibition of pancreatic flow by the intravenous injection of epinephrin, the induction of a flow by the absence or insufficiency of the adrenals presents a potent argument for specificity of control by one gland over the other. This control seems none the less specific, even though possibly caused by the vasomotor properties of epinephrin, but,

[1] Adrenalin is the variety of epinephrin used throughout these experiments, except in some early work where the change was noted.

[2] Edmunds, Jour. Exper. Pharmacol., June, 1909, vol. i.

in the observation just recorded there is apparently evidence that vasomotor control is not the only factor operating. Even if it is the only factor, the pancreas shows such a degree of susceptibility to the presence or absence of epinephrin as to indicate specificity on this score.

We have tried to establish controls, and have attempted to produce the same results by means of some abdominal injury, on the basis that nervous stimulation or inhibition produced by the removal of the adrenals, induces secretion. Such action would presumably take place much sooner than does the flow in question, but, to investigate the matter we have, in ten instances, removed one adrenal only, especially the right, in order to produce approximately the same amount of disturbance and trauma that occur when both adrenals are removed. This latter injury would be closely simulated, since the removal of the left adrenal, as elsewhere remarked, is relatively easily and quickly accomplished. The left adrenal has also been removed alone, and, again, we have handled and bluntly dissected both adrenals, about as we do in extracting them, without, however, destroying their functionating power, or blood supply. In all these cases, however, we have been unable to produce the conditions described as occurring when both adrenals are removed. The instances of removal of one adrenal were about equally divided between a moderate flow and no flow at all, and the instance of blunt dissection of both adrenals without conscious injury to their function, gave absolutely no flow whatever.

It will be noted in the accompanying protocols that in some instances of ablation the dog died before evidence could be obtained one way or the other. Again, others died when a flow had but just begun. These latter distinctly illustrate the point at issue, and yet the accidents and uncertainties of anesthetization make statistical use of them practically impossible.

In a few words, the order of events seems to be that a dog with the adrenals removed gives a marked flow; a dog with one adrenal removed tends to give some flow, though less and often none; and a dog with the adrenals intact gives practically no flow at all, or relatively little.

We have also introduced a cannula into the hepatic duct to determine if the output of bile were increased, but have observed no flow in the instances tried, although the pancreas secreted actively. We expect to try the same thing on the salivary and other glands.

ALLIED PROBLEMS

We feel that with the methods of procedure hitherto used the subject is not susceptible of much greater solution, and, because of our desire to approach it by other means, it seems wise to publish what we have done to date before taking up other measures or topics. Some of the studies which we have in mind are:

1. Experiments with duodenal secretin and epinephrin on dogs with adrenals ablated when showing a flow or a beginning tendency to flow.
2. Examination of the pancreatic juice secreted at various periods in all the conditions described above.
3. Transfusion of the blood from a normal dog into one whose pancreas is secreting after ablation.
4. Transfusion of the blood of a secreting dog with adrenals ablated into a normal dog whose pancreas can be watched after the usual method.
5. The production of hemorrhage in a secreting dog with adrenals ablated.
6. Efforts to detect epinephrin in the blood at various periods of the above experiment.
7. Destruction of the adrenals by agents which will not seriously disturb the general economy.
8. Removal of the pituitary body under analogous circumstances, etc.

A number of such problems demands investigation and promises information of value in regard to our present imperfect conceptions of the adrenals and other ductless glands.

OBSERVATIONS ON DUODENAL SECRETIN

One series of observations, in line with the projected work just outlined, and planned with the idea of throwing light on the main problem, we have taken up. It is not as yet complete, because the methods employed have proved inadequate to a satisfactory definition of the results, but there seems to be indicated a condition which is at once surprising and indicative of interesting possibilities.

On observing the marked flow of pancreatic juice in dogs whose adrenals had been removed, it seemed to us that the pancreas might be conceivably acting as the result of a change in some one of the stimulating factors rather than as a result of the removal of inhibition alone. Or, again, a combination of these might be operative. We therefore turned our attention to the secretin content of the duodenum, with a view to ascertaining whether or not it was affected by the absence of the adrenals or their products.

METHOD OF WORK

An examination of this kind proved troublesome because of the difficulty in having the varying terms of the experiment constant. It was necessary to make a preparation of secretin from the intestines of a dog with adrenals ablated, and to compare it with secretin made from a normal dog killed for that purpose. It was then necessary to compare secretin made from a normal dog which had died under similar conditions of anesthesia after a long period, with secretin from a normal dog killed for the purpose.

These comparisons were made by injecting the solutions into a normal dog, the activity of whose pancreas could be observed by means of a cannula in the pancreatic duct. Coincident records were made of the blood pressure and respiratory movements of the injected dog, as well as the time in seconds. It was desirable to compare directly secretin made from a dog with adrenals ablated, with that from a normal dog which had died after a com-

parably long etherization, the flow from whose pancreas had been observed and found to be slight. Because of the physical limitations to our facilities for work, however, this last could not be accomplished, and we had to compare each of these with a control. Such controls varied among themselves according to the varying amounts of secretin in the intestines of the normal dog, but were, of course, constant for given comparisons.

The secretin solutions were made by taking definite lengths, two to four feet, of intestine from the experimental and control animals and removing the mucosa. Equal weights of these scrapings were then ground up with sand for equal periods in acid of the same strength and treated as described elsewhere,[1] making two solutions, one control and one experimental.

These solutions were decanted and strained. In some of the earlier experiments, when the intestine first worked up gave heavier and more abundant scrapings than the second, proportionately less fluid was used in making the dilutions of the second; but such cases were about equally divided between the control and the other instances, and were later avoided entirely.

Where delay was inevitable between death and the preparation of secretin from an animal which had been operated on, the control dog was killed at the time the former died, and the intestines from both were kept on ice for the same period. In the final tests of these preparations equal amounts were, of course, used, from 3 c.c. to 10 c.c., generally about 5 c.c., and alternately injected into the femoral vein after the first and usually more active response had subsided.

FINDINGS

For convenience of reference we shall designate the secretin made from dogs whose adrenals had been ablated after many hours of observation and flow, "terminal adrenal secretin" or T. A. S.; that from otherwise normal dogs whose pancreatic activity or inactivity had been likewise observed over many hours

[1] Loc. cit.

until death, "terminal normal secretin" or T. N. S.; and that from dogs killed for normal control secretin, "normal secretin" or N. S. All these dogs had fasted for thirty-six hours.

In six experiments in which secretin from a dog whose adrenals had been ablated was tested against normal control secretin, it was weaker twice; twice of about equal strength though possibly stronger; and twice, stronger than the control.

In five experiments in which secretin from an intact animal which had been observed over many hours of relative pancreatic inactivity was tested against a normal control secretin, it was in every instance distinctly weaker.

That the terminal normal secretin should be weaker than the normal secretin was perhaps to be expected *a priori.*

On the other hand, that terminal adrenal secretin, T. A. S., should ever be as strong as the control from a healthy fresh animal, N. S. is surprising, especially in view of the consistently uniform inferiority of the terminal normal secretin (T. N. S.) as compared with the normal secretin (N. S.).

In point of fact, however, the terminal adrenal secretin, T. A. S., was sometimes actually stronger than the secretin from a strong healthy dog. It can hardly be doubted that it would have shown a proportionately greater contrast of strength, if tested against its true analogue, terminal normal secretin (T. N. S.).

The table shows this more graphically:

N. S.	>	T. N. S
N. S.	>	T. N. S
N. S.	>	T. N. S
N. S.	>	T. N. S
N. S.	>	T. N. S

N. S.	<	T. A. S.	.....	See exp. 44	.....	1	12	10
N. S.	<	T. A. S.	.....	See exp. 42	.....	1	7	10
N. S.	>	T. A. S.	.....	See exp. 47	.....	2	18	10
N. S.	>	T. A. S.	.....	See exp. 43	.....	2	9	10
N. S.	=	T. A. S.	.....	See exp. 45	.....	2	13	10
N. S.	=	T. A. S.	.....	See exp. 46	.....	2	14	10

No definite preponderance in favor of either in the last two instances.

DISCUSSION OF FINDINGS

We must infer from this that our experiments, as far as they go, indicate some peculiarity of the duodenal mucosa in dogs which have had their adrenals removed. By virtue of this it seems to have properties more stimulating to the pancreas, when extracts are made from it, than has the mucosa of normal dogs subjected to the same procedure, or even, sometimes, that of healthy, vigorous animals freshly killed.

If these results be corroborated, they may prove to be of further interest. Not only would they further indicate a control over the pancreas by the adrenals, but they would suggest a view of the adrenals as organs related to intestinal digestion. This is by no means proved as yet, and we do not wish to be interpreted as postulating it, but the evidence along this line is not without interest.

It is interesting to note that if the pancreas secretes more actively in the absence of the usual suprarenal products, vasomotor or of whatever nature, this activity is apparently supplemented and strengthened by the presence in increased amounts of the normal excitors in the intestine. These may be manifestations of one and the same process, hyperstimulation from the intestine, but we are not inclined to this view, as in some instances in which we recorded a very active flow, the activity of the terminal adrenal secretin was not proportionately great, though apparently always greater than the terminal normal secretin. It is conceivable that the terminal adrenal secretin is stronger than the terminal normal secretin, because the terminal adrenal dogs die before it becomes so much reduced as in the others, and yet many of them live so long as to make this difference negligible. This would not explain, in any event, those cases in which the terminal adrenal secretin was equal to, or in two cases stronger than, the normal.

As to the cause of the presence of more than the normal amount of secretin in terminal adrenal dogs, no answer can be given except that, if vascular control be the explanation of this property

of the suprarenals, a conceivable determination of more blood to the intestinal mucosa in the ablated animal might afford more of the factors from which the excitor is normally formed.

Observations of this general type on the factors which conduce to the formation of secretin may throw light on its nature and the substances that are necessary to its composition.

One or two further points require notice. The first is that, noticing frequently in cases of terminal adrenal flow a congestion of the viscera, we thought it possible that stasis might be the cause of the pancreatic output, although observations in the past by others[1] have shown that there occurs no postmortem flow from the pancreas due to stasis.

As reference to our protocols will indicate, we studied every animal at autopsy with a view to observing this and other features, but could find no evident relation between the extent and degree of congestion and the flow from the pancreas. In no instance did the pancreas at autopsy show any marked degree of congestion. It never showed the picture of passive congestion such as is caused by interference with the portal outflow, but was often pale.

Occasionally there occurs, after removal of an adrenal gland, a slow oozing from its previous site which is not apparent at first, and is hard to foresee or control. This happened in four instances. In one of these we had looked for the usual terminal adrenal flow and were surprised at not getting it until the somewhat early fall of blood pressure and premature death of the dog revealed considerable hemorrhage into the abdominal cavity.

Such observations have inclined us to believe that under circumstances in which a terminal adrenal flow is to be expected, hemorrhage will prevent it, and, indeed, it is possible that it will also prevent the greater activity of secretin made from terminal adrenal mucosa. This may explain the only two instances in which terminal adrenal secretin was weaker than normal secretin as indicated in the table (Experiments 43 and 47). There also

[1] Bainbridge, Brit. Jour. Physiol., vol. xxxiv, p. 280.

seems to be in this an argument against the probability that a low blood pressure *per se* is the determining factor in the flow under discussion, since hemorrhage must contribute to conditions of low blood pressure, but, at the same time, apparently prevents or modifies the flow.

We wish here to call attention again to a certain feature which we emphasized in our first contributions on pancreatic activity.

Among other conclusions there presented were the following:

1. There would seem to be some factor which makes the preparation of secretin from human intestines more difficult than from the intestines of some animals.

2. This factor may depend on the relatively great abundance of membrane in these animals and consequently greater amount of prosecretin.

3. The abundance of mucosa may be in part a provision of nature in order that the strongly acid chyme of some animals may meet with a quantity of pancreatic juice sufficient to neutralize it and effect digestion.

4. Dieting and fasting seem to have no appreciable effect on the activity of an extract.

5. Time elapsed between death and the preparation of the extract (within limits) does not seem to be a factor. . . .

It will be noticed that prosecretin is apparently abundant in the duodenum of dogs and that it is more difficult of detection in the duodenum of human beings. In these latter instances, however, the quantity of mucosa obtained is frequently abundant, and gives no *a priori* indication of the difficulty to be met in obtaining an active extract of its prosecretin. Granting that the mucosa is less plentiful in human beings, it would be expected that secretin solutions made therefrom would be inferior to those made from dogs, but there still remains the difficulty of accounting for the apparent entire absence of secretin in the cases of various diseases which we reported.

It appears that our recent observations help to elucidate this point. We have seen that, in every case examined, the terminal

normal secretin (T. N. S.) was weaker than the normal secretin, being extracts made respectively from dogs which had died a lingering protracted death over twelve to eighteen hours, on the one hand, and, from lively animals killed during health, on the other. In our earlier work, and in the work of the few others who have attempted such observations, comparisons were made between the secretin from human beings who had died "slowly," as is generally the case with hospital subjects, and that from animals recently killed as recorded.

We seem to have here illustrated, therefore, one of the factors which may be, and doubtless are, operative to prevent or hamper the detection of prosecretin in the diseased human subject. The effect of a lingering death is apparently to make the prosecretin content of the duodenum less easy of extraction and perhaps the mucosa less active, as contrasted with freshly killed animals.

We have made a few observations on the nature of the pancreatic juice which is secreted at various periods during a flow, and tests of its amylolytic power indicate very clearly that, while the juice becomes weaker as it is poured out in larger and larger quantities over long periods, it preserves this one ferment action at least to a very significant degree.

This question, however, is almost one by itself and requires special work devoted to it, but the presumption is all in favor of the view that the other ferments of the juice are also present.

CONCLUSIONS

1. The removal of the suprarenal glands induces in dogs a flow of pancreatic juice. This has been equalled in duration and activity only by the processes, natural or experimental, which depend on activation by duodenal secretin.

2. Taken in connection with the inhibitory action of suprarenal and pituitary extracts on the pancreatic flow, this suggests a control over the pancreas, by the adrenals at least, in the absence of which the gland secretes more actively.

3. This activation of the pancreas may occur with a high systemic blood pressure, though it generally occurs when the systemic blood pressure is relatively low. Hemorrhage may modify or prevent it.

4. There is some evidence to indicate that on the death of a dog from removal of the adrenals, there is present in the duodenum more prosecretin than exists in dogs otherwise operated on which have their adrenals intact, and which die after a comparably long period of etherization. This preponderance may be a contributory factor in the production of a flow.

5. One of the factors which seem to make detection of prosecretin in human beings difficult is probably the lingering death of most of those from whom the intestinal extracts are made. In clinical investigations of secretin, comparisons should not be made between such preparations and those from freshly killed animals, unless this fact be borne in mind.

PROTOCOLS

The following records are abstracts of our experiments, and are for the most part self-explanatory. The first column indicates the time, either directly or in terms of the intervals, between the events recorded. The second column indicates the flow of pancreatic juice, in terms of cannulas or divisions of the cannula.

The same cannula was used practically throughout and contained ninety divisions. Occasionally we failed to record when it was exactly full, the excess being generally estimated on the ungraded distal end.

The last column indicates the blood pressure in millimeters of mercury. The records of the secretin injections show the pancreatic output in terms of cannulas and fractions of a cannula, the latter giving the actual divisions reached.

The first table below indicates the observations on which we based our first report in May, 1909. They were on animals fed at various periods before the operation, in most of whom digestion

was taking place more or less rapidly. We were assisted in making these observations by Dr. Stone and Dr. Rulon, then of the fourth-year class in the Medical School of the University of Pennsylvania.

Finally, we wish to express our obligation to Dr. Edward T. Reichert for the facilities he has placed at our command which have made possible the observations and studies here recorded. We also desire again to thank Dr. David L. Edsall for the kindly interest and encouragement which have aided us so materially in all our work.

OBSERVATIONS WHICH FORMED THE BASIS OF THE FIRST REPORT

Personally Conducted Observations

Normal dogs.	Dogs from which the adrenals had been removed.
O T O + (!) T O	+ + (!) T +

Observations Conducted Chiefly by Dr. Stone and Dr. Rulon.

O	+ + +

O = no flow.
T = no "terminal" flow.
(!) = a violent flow in the instance immediately preceding it.
+ = a well-marked flow.

Summary of Present Results.

Normal control with flow	0
Normal control with no flow	6
Adrenals out with flow	9
Adrenals out with no flow	0
One adrenal out with flow; 1, violent; 1, marked (worms and blood in duodenum); 2, slight; 1, moderate; total	5
One adrenal out with no flow	4
One adrenal out; failure (clot in cannula)	3
Abdominal injury with flow (chyme in intestine)	1
Abdominal injury with no flow	1
Adrenals out; early death with flow	5
Adrenals out; early death with no flow	6
One adrenal out; early death with no flow	1
Total	41

Group 1.—Normal Controls

EXPERIMENT 1. DECEMBER 29, 1909: NORMAL DOG, NO FLOW

			Blood pressure.
9.45 A.M.	Ether.	Flow active (9 hours).	
	83 min. later.	First cannula full.	148
1.05 P.M.	1 hr. 49 sec. later.	Second cannula full.	80
	2 hr. 20 min. later.	Third cannula full.	70
4.01 P.M.	1 hr. 24 min. later.	Fourth cannula full.	80
	1 hr. 17 min. later.	Fifth cannula full.	75[1] / 45[1]
6.09 P.M.	27 min. later.	Flow.	40
	6 min. later.	Sixth cannula full.	20
	19 min. later.	80 on cannula.	16
6.34 P.M.	Death.		

Considerable congestion. Spleen small, but rather dark blue. Other organs not congested. Stomach and duodenum empty. Intestines show some stasis, but not nearly so great perhaps as some dogs show with adrenals removed. Intestines used for secretin.

EXPERIMENT 2, JANUARY 3, 1910: NORMAL, NO FLOW, 36 HOURS FAST.

			Blood pressure.
9.20 A.M.	Ether.		78
	1 hr. 27 min. later.	First cannula full.	90
	1 hr. 42 min. later.	Second cannula full.	94
	51 min. later.	Third cannula full.	86
	41 min. later.	Fourth cannula full.	80
	35 min. later.	Fifth cannula full.	78
	43 min. later.	Sixth cannula full.	66
4.33 P.M.	36 min. later.	Seventh cannula full.	60
	36 min. later.	Eighth cannula full.	66
	33 min. later.	Ninth cannula full.	64
	30 min. later.	Tenth cannula full.	50
	26 min. later.	Eleventh cannula full.	clot
7.34 P.M.	30 min. later.	Twelfth cannula full.	36
7.53 P.M.	19 min. later.	64 divisions.	
Death.			

Blood pressure was low and early became low for a normal dog, indicating some analogy to the condition after long etherization or removal of adrenals. Intestine very slightly congested. Spleen markedly so in areas. Stomach and intestine alkaline in reaction.

[1] Fluctuation of blood pressure with each respiration.

EXPERIMENT 3, JANUARY 13, 1909: NORMAL DOG, NO FLOW

			Blood pressure.
9.30 A.M.	Ether.		180
	4 hr. 12 min. later.	First cannula full.	154
3.30 P.M.	2 hr. 16 min. later.	Second cannula full.	160
5.14 P.M.	1 hr. 28 min. later.		120
	1 hr. 3 min. later.	Third cannula full.	136
	1 hr. 30 min. later.	Fourth cannula full.	105
	1 hr. 12 min. later.	Fifth cannula full.	58
	1 hr. 20 min. later.	Sixth cannula full.	108
	59 min. later.	Seventh cannula full.	80
	45 min. later.	Eighth cannula full.	70
	18 min. later.	69 divisions.	Death.

Typical nutmeg liver. Apparently respiratory death after fourteen hours. Death somewhat sudden.

EXPERIMENT 4, FEBRUARY 24, 1910: NORMAL DOG, NO FLOW

		Blood pressure
9.37 A.M.	Drum starts.	136
12.15 P.M.	35½ divisions.	134
	Sucked out as cannula was removed and replaced, thinking the duct possibly blocked. O. K., however.	
4.01 P.M.	28 divisions.	130
4.53 P.M.		104
6.39 P.M.	31 divisions.	108
7.40 P.M.	Cannula taken out and replaced for the second time. O. K., however; cannula emptied.	
	28 divisions.	
9.23 P.M.	43 divisions.	94
9.57 P.M.	44 divisions.	92
	Blood pressure actually much lower as, owing to an unrecognized clot, it had not fallen and went no lower, even at death.	
10.27 P.M.	Death.	90

Duct clear. Pancreas appeared normal. Intestines congested where handled, otherwise normal. Stomach empty and contracted. Spleen mottled, not bullous. Liver and kidneys show fatty degeneration. Lungs not collapsed, anthracotic. Heart greatly hypertrophied. Adrenals very hemorrhagic.

EXPERIMENT 5, FEBRUARY 28, 1910: NORMAL DOG, NO FLOW

			Blood pressure.
9.05 A.M.	Ether.		134
10.43 A.M.		First cannula full.	136
1.41 P.M.	2 hr. 48 min. later.	Second cannula full.	144
3.55 P.M.		Third cannula full.	136
	1 hr. 32 min. later.	Fourth cannula full.	110
7.04 P.M.	1 hr. 37 min. later.	Fifth cannula full.	106
8.46 P.M.	1 hr. 53 min. later.	Sixth cannula full.	106
9.40 P.M.	56 min. later.	Seventh cannula full.	82
10.30 P.M.	52 min. later.	Eighth cannula full.	60
11.31 30 sec.	52 min. later.	Ninth cannula full.	60
12.00 P.M.	30 min. later.	Tenth cannula full.	42
12.27 A.M.	29 min. later.	Eleventh cannula full.	42
1.01 A.M.	36 min. later.	Twelfth cannula full.	46
1.42 A.M.	41 min. later.	Thirteenth cannula full.	28
1.48 A.M.	7 min. later.	30 divisions. Experiment lasted seventeen hours.	

Death.

Liver shows fatty change and some nutmeg appearance. Duct clear. Intestines empty and not congested. Stomach empty.

EXPERIMENT 6, APRIL 8, 1910: NORMAL CONTROL, NO FLOW

		Blood pressure.
9.30 A.M.	Ether.	
9.53 A.M.	Tracing began	146
1.02 P.M.	No flow	120
3.45 P.M.	No flow	120
5.50 P.M.	No flow	106
7.54 P.M.	No flow	114
9.00 P.M.	No flow	116
10.49 P.M.	No flow	76
12.13 A.M.	More ether given	108
12.40 A.M.	No flow	58
1.00 A.M.	No flow	46
1.14 A.M.	Death.	

This dog might have lived many hours yet, as blood pressure was 108 at midnight; therefore, as the artificial condition of etherization was desired, and no ether had been given for some time except in small amounts, it was added until the blood pressure fell. Otherwise the observation would have been equivalent to watching a healthy normal dog indefinitely.

Liver not congested. Spleen contracted, normal in color. Duct clear. Stomach empty. Adrenals, distinctly large for a dog of this size (fox-terrier bitch), show a brown liquid medulla, hemorrhagic junction of medulla and cortex and lighter periphery to cortex. Intestines empty, not congested.

Group 2.—Both Adrenals Removed[1]

Experiment 7, December, 1909: adrenals out and flow

			Blood pressure.
11.40 A.M.	Ether.		
11.58 A.M.	L. A. O.		96
	1 hr. 26 min. later.	First cannula full.	100
	38 min. later.	Second cannula full.	96
	47 min. later.	Third cannula full.	108
	1 hr. 50 min. later.	Fourth cannula full.	78
	1 hr. 9 min. later.	Fifth cannula full.	48
	20 min. later.	Sixth cannula full.	54
	14 min. later.	Seventh cannula full.	42
	4 min. later.	Eighth cannula full.	46
	2 min. 30 sec. later.	Ninth cannula full.	46
	3 min. later.	Tenth cannula full.	46
	4 min. later.	Eleventh cannula full.	42
	6 min. later.	Twelfth cannula full.	44
	11 min. later.	Thirteenth cannula full.	44
	10 min. later.	Fourteenth cannula full.	clot
	6 min. later.	Fifteenth cannula full.	50
	5 min. 30 sec. later.	Sixteenth cannula full.	50
	6 min. later.	Seventeenth cannula full.	50
	5 min. later.	Eighteenth cannula full.	50
	5 min. later.	Nineteenth cannula full.	50
	4 min. 30 sec. later.	Twentieth cannula full.	46
	5 min. later.	Twenty-first cannula full.	42
	4 min. 30 sec. later.	Twenty-second cannula full.	38
	3 min. later.	Twenty-third cannula full.	34
	2 min. later.	Twenty-fourth cannula full.	34
	1 min. 50 sec. later.	Twenty-fifth cannula full.	34
	1 min. 50 sec. later.	Twenty-sixth cannula full.	30
	2 min. 50 sec. later.	Twenty-seventh cannula full.	26

7.23 P.M. Death. Stomach and intestines free from food. Time of removal of right adrenal inadvertently omitted, but it was earlier than the removal of the left.

[1] R. A. O. = Right adrenal out. L. A. O. = Left adrenal out. S. O. = "Sucked out" = cannula emptied and record begins anew.

EXPERIMENT 8, DECEMBER 20, 1909: ADRENALS REMOVED; FLOW

			Blood pressure.
10.40 A.M.	Tracing begun; forty-eight hours fast.		110
10.48 A.M.	R. A. O.		
11.08 A.M.	L. A. O.		
11.10 A.M.	Juice at 77.		
	12 min. later.	First cannula full.	90
	1 hr. 41 min. later.	Second cannula full.	96
	1 hr. 16 min. later.	Third cannula full.	90
2.30 P.M.	17 min. later.		
	1 hr. 16 min. later.	Fourth cannula full.	80
	1 hr. 19 min. later.	Fifth cannula full.	70
	30 min. later.	Sixth cannula full; flow began.	66
	11 min. later.	Seventh cannula full.	66
	8 min. 30 sec. later.	Eighth cannula full.	70
	9 min. later.	Ninth cannula full.	74
	9 min. later.	Tenth cannula full.	76
	7 min. 30 sec. later.	Eleventh cannula full.	76
	8 min. 30 sec. later.	Twelfth cannula full.	76
	9 min. 30 sec. later.	Thirteenth cannula full.	80
	12 min. later.	Fourteenth cannula full.	82
	15 min. later.	Fifteenth cannula full.	82
	18 min. later.	Sixteenth cannula full.	82
	21 min. later.	Seventeenth cannula full.	90
	1 hr. 13 min. later.[1]	Eighteenth cannula full.	50
	56 min. later.	15 divisions.	
10.00 P.M.	Death.		

Cannula probably O. K. Stomach acid, brown fluid; no congestion. Spleen congested; liver not.

Then S. O. to 52.

EXPERIMENT 9, DECEMBER 22, 1909: ADRENALS OUT, WITH FLOW[1]

10.30 A.M. Ether begins.
10.48 A.M. R. A. O.
11.08 A.M. L. A. O.
11.22 A.M. Drum starts.

			Blood pressure.
11.27 A.M.		Cannula full.	134
	1 hr. 6 sec. later.	First cannula full.	120
	1 hr. 7 sec. later.	Second cannula full.	102
	1 hr. 39 min. later.	Third cannula full.	92
	53 min. later.	Fourth cannula full.	66
	30 min. later.	Fifth cannula full.	49
	12 min. later.	Sixth cannula full.	46
	11 min. later.	Seventh cannula full.	46
	4 min. later.	Eighth cannula full.	46
	3 min. 30 sec. later.	Ninth cannula full.	44
	3 min. 30 sec. later.	Tenth cannula full.	clot
	4 min. later.	Eleventh cannula full.	32

6.06 P.M. Death.

Small amount of ether apparently caused death. Spleen bullous and very congested. Liver moderately congested. Kidneys moderately congested. Intestines greatly congested and almost black in upper part of duodenum. Intestines and stomach empty, and alkaline or neutral.

EXPERIMENT 10, JANUARY 6, 1910: ADRENALS OUT WITH FLOW, BUT EARLY DEATH

9.45 A.M. R. A. O.
10.00 A.M. L. A. O.
10.18 A.M. Drum.

			Blood pressure.
10.25 A.M.			88
	2 hr. 9 min. later.	First cannula full.	40
	24 min. later.	Second cannula full.	20
	17 min. later.	Third cannula full.	20
	8 min. 30 sec. later.	Fourth cannula full.	20
	8 min. 30 sec. later.	Fifth cannula full.	20
	22 min. later.	55 divisions.	

Death.

Much bile extruded. Intestines and liver not much congested. Spleen considerably congested. Stomach alkaline. Stomach empty, except for bile and a plum stone.

[1] Operative proceduers in following order: Adrenals out, cannula in pancreas, respiratory cannula, blood pressure.

EXPERIMENT 11, JANUARY 10, 1910: ADRENALS REMOVED, MODERATE FLOW AND EARLY DEATH

Cannula in bile-duct.
9.20 A.M. Ether.
9.40 A.M. R. A. O.
9.48 A.M. L. A. O.

		Blood pressure.
10.22 A.M.	Drum starts.	124
	31 min. later. First cannula full.	114
	42 min. later. Second cannula full.	100
	Fall of blood pressure from manipulation of intestines to replace cannula in bile duct.	44
	31 min. later. Fourth cannula full.	28
	18 min. 30 sec. later. Fifth cannula full.	16
	7 min. 30 sec. later. Sixth cannula full.	10
1.06 P.M.	Death.	

Spleen greatly congested, though not bullous. Stomach somewhat congested and considerable bile. Liver moderately congested. Intestines locally hemorrhagic where handled and somewhat darkened throughout. Twelve c.c. bile altogether. No flow of bile at end.

EXPERIMENT 12, JANUARY 11, 1910: ADRENALS REMOVED, WITH FLOW

			Blood pressure.
9.38 A.M.	Ether.		
10.08 A.M.	R. A. O.		146
10.18 A.M.	L. A. O.		104
	32 min. later.	First cannula full.	
	16 min. later.	Second cannula full.	110
	50 min. later.	Third cannula full.	120
	25 min. later.	Fourth cannula full.	124
	30 min. later.	Fifth cannula full.	112
	32 min. later.	Sixth cannula full.	102
	25 min. later.	Seventh cannula full.	90
	20 min. later.	Eighth cannula full.	80
	24 min. later.	Ninth cannula full.	80
	22 min. later.	Tenth cannula full.	70
	10 min. later.	Eleventh cannula full.	clot
	9 min. later.	Twelfth cannula full.	60
	8 min. 30 sec. later.	Thirteenth cannula full.	60
	6 min. later.	Fourteenth cannula full.	50
	2 min. 30 sec. later.	Fifteenth cannula full.	44
	2 min. 30 sec. later.	Sixteenth cannula full.	44
	4 min. later.	Seventeenth cannula full.	44
	5 min. later.	Eighteenth cannula full.	44
	4 min. later.	Nineteenth cannula full.	44
	3 min. later.	Twentieth cannula full.	40
	2 min. 15 sec. later.	Twenty-first cannula full.	40
	1 min. 45 sec. later.	Twenty-second cannula full.	34
	1 min. 30 sec. later.	Twenty-third cannula full.	34
	1 min. 15 sec. later.	Twenty-fourth cannula full.	
	1 min. 15 sec. later.	Twenty-fifth cannula full.	30
	1 min. later.	Twenty-sixth cannula full.	30
	50 sec. later.	Twenty-seventh cannula full.	30
	40 sec. later.	Twenty-eighth cannula full.	24
	32 sec. later.	Twenty-ninth cannula full.	24
	36 sec. later.	Thirtieth cannula full.	24
	30 sec. later.	Thirty-first cannula full.	22
	30 sec. later.	Thirty-second cannula full.	20
	1 min. 10 sec. later.	Thirty-third cannula full.	20
	3 min. later.	Thirty-fourth cannula full.	14
4.00 P.M.	Death.		

Liver not congested. Spleen moderately congested; very dark. Stomach empty; slight amount of chyme. No congestion of intestines anywhere, except at a few spots opposite cannula where handled. No flow of bile to speak of.

EXPERIMENT 13, FEBRUARY 3, 1910: ADRENALS REMOVED; FLOW

			Blood pressure.
9.45 A.M.	L. A. O.		
9.53 A.M.	R. A. O.		
10.14 A.M.	Drum starts.		130
	59 min. later.	First cannula full (overfull).	132
	41 min. later.	Second cannula full.	138
	12 min. later.	Third cannula full.	140
	14 min. 30 sec. later.	Fourth cannula full.	130
	15 min. later.	Sixth cannula full (overfull).	132
	4 min. later.	Seventh cannula full.	126
	5 min. 30 sec. later.	Eighth cannula full.	126
	6 min. later.	Ninth cannula full.	112
	9 min. later.	Tenth cannula full.	110
	4 min. 30 sec. later.	Eleventh cannula full.	102
	4 min. 30 sec. later.	Twelfth cannula full.	98
	4 min. later.	Thirteenth cannula full.	104
	4 min. later.	Fourteenth cannula full.	90
	4 min. 30 sec. later.	Fifteenth cannula full.	90
	4 min. 30 sec. later.	Sixteenth cannula full.	86
	6 min. later.	Seventeenth cannula full.	84
	7 min. later.	Eighteenth cannula full.	88
	3 min. later.	Nineteenth cannula full.	86
	3 min. 55 sec. later.	Twentieth cannula full.	80
	5 min. 30 sec. later.	Twenty-first cannula full.	76
	7 min. later.	Twenty-second cannula full.	70
	5 min. 10 sec. later.	Twenty-third cannula full.	72
	22 min. later.	Twenty-fourth cannula full.	Death.

Position of blood pressure above base line somewhat doubtful. Autopsy shows nothing of importance. Spleen shows very small areas of extreme congestion. Intestines show hemorrhagic congestion at edges of folds in that area which was subjected to handling.

EXPERIMENT 14, APRIL 4, 1910: ADRENALS REMOVED; MODERATE FLOW

			Blood pressure.
10.25 A.M.	R. A. O.		
10.35 A.M.	L. A. O.		
10.58 A.M.	Drum starts.		
	28 min. later.	Juice flowing O. K.	
	11 min. later.	First cannula full.	130
	6 min. 30 sec. later.	Second cannula full.	128
	11 min. later.	Third cannula full.	132
	23 min. later.	Fourth cannula full.	104
	43 min. later.	Fifth cannula full.	102
	13 min. 30 sec. later.	Sixth cannula full.	104
	3 min. later.	Seventh cannula full.	112
	9 min. 30 sec. later.	Eighth cannula full.	104
	7 min. later.	Ninth cannula full.	104
	29 min. later.	Tenth cannula full.	98
	43 min. later.	Eleventh cannula full (overfull).	92
	11 min. later.	Twelfth cannula full.	82
	8 min. 30 sec. later.	Thirteenth cannula full.	78
	42 min. later.	Fourteenth cannula full.	62
4.00 P.M.	Death.		

Autopsy showed no congestion of intestine. A small clot was found in opening of cannula, possibly partially occluding the duct.

EXPERIMENT 15, FEBRUARY 8, 1910: ADRENALS REMOVED; HEMORRHAGE; FLOW

			Blood pressure.
9.50 A.M.	R. A. O.		
10.10 A.M.	L. A. O.		
10.25 A.M.	Drum starts.		160
	1 hr. 51 min. later.	First cannula full.	114
	1 hr. 8 min. later.	Second cannula full.	102
	1 hr. 40 min. later.	Third cannula full.	62
	15 min. later.[1]	Fourth cannula full.	60
	3 min. 30 sec. later.	Fifth cannula full.	60
	3 min. 30 sec. later.	Sixth cannula full.	60
	3 min. later.	Seventh cannula full.	64
	3 min. 30 sec. later.	Eighth cannula full.	72
	3 min. 10 sec. later.	Ninth cannula full.	70
	3 min. 50 sec. later.	Tenth cannula full.	64
	4 min. later.	Eleventh cannula full.	64
	5 min. 10 sec. later.	Twelfth cannula full.	64
3.54 P.M.:			
	13 min. 30 sec. later.	Thirteenth cannula full at seventieth division.	
Death.			

[1] Flow begins 3 P.M.

Stomach empty, except for a little bile, as are also the intestines. Pancreas paler than normal. Duct clear and free, extensive hemorrhage in abdomen; few clots; no congestion of intestine and stomach, except for a few spots on the intestines where handled. Blood in abdomen probably 25 per cent. of total blood or more. No supernatant serum. Liver normal in color. No terminal flow. Spleen blue and slightly roughened; rather hard and apparently not swollen. Kidneys not so blue as usual. Apparently no general congestion; little, if any anywhere.

EXPERIMENT 16, FEBRUARY 12, 1910: ADRENALS REMOVED AND FLOW

			Blood pressure.
9.50 A.M.			150
10.25	R. A. O.		
10.40	L. A. O.		76
11.29		First cannula full.	76
12.04	35 min. later.	Second cannula full.	76
12.30	26 min. later.	Third cannula full.	70
12.51	21 min. later.	Fourth cannula full.	70
1.11.30 P.M.:			
	20 min. 30 sec. later.	Fifth cannula full.	50
1.30	18 min. 30 sec. later.	Sixth cannula full.	44
1.43	13 min. later.	Seventh cannula full.	40
1.48	5 min. later.	Eighth cannula full.	36
1.49.10	1 min. 10 sec. later.	Ninth cannula full.	36
1.50.30	1 min. 20 sec. later.	Tenth cannula full.	36
1.51.18	48 sec. later.	Eleventh cannula full.	34
1.52.13	55 sec. later.	Twelfth cannula full.	30
1.55.8	55 sec. later.	Thirteenth cannula full.	30
1.53		79th division.	Death.

EXPERIMENT 17, FEBRUARY 17, 1910: ADRENALS REMOVED; FLOW

		Blood pressure.
9.50 A.M.		136
10.11 A.M.	R. A. O.	
10.32 A.M.	L. A. O.	
10.57		86
11.34		96
11.46	First cannula full.	90
1.38 P.M.	Second cannula full.	84
1.42	Third cannula full.	90
1.44.30	Fourth cannula full.	86
1.51.30	Fifth cannula full.	84
1.55.30	Sixth cannula full.	80
2.02	Seventh cannula full.	78
2.05	Eighth cannula full.	80
2.07.30	Ninth cannula full.	80
2.15.30	Tenth cannula full.	70
2.26	Eleventh cannula full.	70
2.41.30	Twelfth cannula full.	66
2.44.30	Thirteenth cannula full.	64
2.48.30	Fourteenth cannula full.	52
2.57.30	Fifteenth cannula full.	56
2.59	Sixteenth cannula full.	54
3.05	Seventeenth cannula full.	46[1]
3.18	Eighteenth cannula full.	44
3.47.30	Nineteenth cannula full.	42
4.02.30	Death.	

Three hundred c.c. blood-stained fluid in peritoneum. Duct clear. Spleen moderately congested. Liver more congested. Intestines hemorrhagic high up.

[1] Ether added and it rises to 100.

Group 3.—Adrenals Removed; Early Death

EXPERIMENT 18, DECEMBER 13, 1910: ADRENALS REMOVED AND FLOW

No mention by accident of time of removal of left adrenal.

			Blood pressure
9.30 A.M.	Ether.		150
9.47 A.M.	R. A. O.		
	48 min. later.	First cannula full.	86
	48 min. later.	Second cannula full.	50
	17 min. later.	Third cannula full.	22
	2 min. 40 sec. later.	Fourth cannula full.	18[1]
	5 min. later.	Fifth cannula full.	
12.10 P.M.	Death.		

Fasted twenty-four hours, but stomach contained small amount of water and very small amount of food. Duodenum deeply congested. Intestine contained chyme throughout entire length.

EXPERIMENT 19, DECEMBER 17, 1909: ADRENALS REMOVED; EARLY DEATH; NO FLOW

			Blood pressure.
9.58 A.M.	R. A. O.		
10.03 A.M.	L. A. O.		
10.24 A.M.	Drum starts.		110
	1 hr. 22 min. later.	Death.	98

Slight flow during that time, but no cannula filled.

EXPERIMENT 20, DECEMBER 18, 1910: ADRENALS REMOVED; HEMORRHAGE; NO FLOW; EARLY DEATH

			Blood pressure.
9.48 A.M.	R. A. O.		variable 104 to 130
9.59 A.M.	L. A. O.	Hemorrhage from neck.	80
	1 hr. 14 min. later.	First cannula full, S. O. to 10.	32
	Very long cannula, not generally used.		
	37 min. later.	Cannula 14 divisions.	Death.

Intestine, spleen, liver, and kidneys deeply congested. Pancreas not congested. Right adrenal broken in removal.

[1] Violent flow.

EXPERIMENT 21, FEBRUARY 2, 1910: ADRENALS REMOVED; EARLY DEATH BUT YET A FLOW

			Blood pressure.
9.30 A.M.	Ether.		
9.45 A.M.	R. A. O.		
9.53 A.M.	L. A. O.		
10.12 A.M.	Drum.		110
	1 hr. 9 min. later.	First cannula full.	94
	50 min. later.	Second cannula full.	20
	3 min. 30 sec. later.	Third cannula full.	clot
	2 min. 30 sec. later.	Fourth cannula full.	clot
12.20 P.M.	6 min. later.	Fifth cannula full.	Death.

Stomach full of bile and some hair. Spleen blue, but not unduly congested. Intestines empty and not congested. Liver not congested.

EXPERIMENT 21, FEBRUARY 7, 1910: ADRENALS REMOVED; NO FLOW; EARLY DEATH

			Blood pressure.
10.00 A.M.	Ether.		
10.14 A.M.	R. A. O.		
10.21 A.M.	L. A. O.		
10.50 A.M.	Drum starts.		94
	Both adrenals torn in removal.		
	35 min. later.	First cannula full.	92
	52 min. later.	Second cannula full.	28
	25 min. later.	Third cannula full.	Death.

EXPERIMENT 23, FEBRUARY 7, 1910: ADRENALS REMOVED; HEMORRHAGE; NO FLOW

			Blood pressure.
1.30 P.M.	R. A. O.		
1.37 P.M.	L. A. O.		
2.00 P.M.	Drum started.		150
	2 hr. 14 min. later.	First cannula full.	130
	1 hr. 25 min. later.	Second cannula full.	40
	1 hr. 5 min. later.	80th division.	Death.

Much hemorrhage in abdomen. No congestion. No flow.

EXPERIMENT 24, FEBRUARY 10, 1910: ADRENALS REMOVED; SLIGHT FLOW; EARLY DEATH

			Blood pressure.
9.45 A.M.	Ether.		
10.00 A.M.	R. A. O.		
10.06 A.M.	L. A. O.		
10.25 A.M.	Drum starts.		130
	7 min. later.	Hemorrhage from neck, about 4 ounces.	110
	3 min. later.		126
	45 min. later.	Dog vomits bile, insufflates and nearly dies, when quiet again blood pressure.	110
	41 min. later.	First cannula full.	84
	29 min. later.	Second cannula full.	64
	11 min. later.	Third cannula full.	54
	9 min. later.	55th division.	Death.

Pancreatic cannula free. Lungs do not collapse on opening thorax.

EXPERIMENT 25, FEBRUARY 11, 1910: ADRENALS REMOVED; EARLY DEATH; NO FLOW

			Blood pressure.
9.35 A.M.	R. A. O.		
9.44 A.M.	L. A. O.		
10.14 A.M.	Drum starts.		94
	1 hr. 40 min. later.	First cannula full.	50
	42 min. later.	85th division.	Death.

Stomach and intestines empty except for bile. Duct clear. Spleen only slightly congested. Intestines much congested everywhere and hemorrhagic in spots throughout. Death too early.

EXPERIMENT 26, FEBRUARY 15, 1910: ADRENALS REMOVED; HEMORRHAGE; NO FLOW; EARLY DEATH

			Blood pressure.
9.27 A.M.	Ether.		180
9.54 A.M.	R. A. O.		
10.03 A.M.	L. A. O.		136
	1 hr. 9 min. later.	40 divisions previously S. O.	100
12.24 P.M.	1 hr. 10 min. later.	First cannula full.	86
1.30 P.M.	1 hr. 7 min. later.	Second cannula full.	74
2.41 P.M.	1 hr. 5 min. later.	Third cannula full.	34
2.50 P.M.	12 min. later.	78th division.	Death.

Five hundred c.c. blood in peritoneal cavity, evidently from the site of right adrenal.

Group 4.—Left Adrenal Removed

EXPERIMENT 27, MARCH 11, 1910: LEFT ADRENAL REMOVED; MODERATE FLOW

		Blood pressure
9.30 A.M.	Tracing began; adrenal torn in removal.	150
9.35 A.M.	L. A. O.	
10.31 A.M.		130
	Juice flowing freely from start.	
11.16 A.M.	. . . . . First cannula full (100).	120
12.50 P.M.	. . . . . Second cannula full.	126
1.59 P.M.	. . . . . Third cannula full.	120
2.50 P.M.	. . . . . Fourth cannula full.	124
3.09 P.M.	. . . . . Fifth cannula full.	80
3.32 P.M.	. . . . . Sixth cannula full.	96
3.44 P.M.	. . . . . Seventh cannula full.	82
4.01 P.M.	. . . . . Eighth cannula full.	92
4.17 P.M.	. . . . . Ninth cannula full.	84
4.31 P.M.	. . . . . Tenth cannula full.	64
4.43 P.M.	. . . . . Eleventh cannula full.	40
4.55.30 P.M.	. . . . . Twelfth cannula full.	30
5.12 P.M.	. . . . . Thirteenth cannula full.	Death.

Some flow all day. Duct contained a small soft loose clot. Pancreas not congested. Moderate amount of blood-stained fluid in abdomen. Spleen very blue and congested, but smooth. Stomach and intestines full of bile, but no food. Slight congestion where handled. Liver somewhat fatty. but not congested. Right adrenal shows striation and hemorrhage in cortex. Medulla soft and relatively empty.

EXPERIMENT 28, MARCH 14, 1910: LEFT ADRENAL REMOVED; SLIGHT FLOW

		Blood pressure
9.10 A.M.	Ether.	184
9.33 A.M.	L. A. O.	126
11.24 P.M.	. . . . . First cannula full.	158
2.26 P.M.	. . . . . Second cannula full (overfull).	136
3.03 P.M.	. . . . . B. P. cannula blows out and 50 c.c. blood lost.	136
3.26 P.M.	. . . . . Third cannula full.	146
4.43 P.M.	. . . . . Fourth cannula full.	128
5.52 P.M.	. . . . . Fifth cannula full (overfull).	84
6.37 P.M.	. . . . . Sixth cannula full.	64
7.22.30 P.M.	. . . . . Seventh cannula full.	52
8.04 P.M.	. . . . . Eighth cannula full.	50
8.35 P.M.	. . . . . Ninth cannula full.	26
8.43 P.M.	. . . . . 43d division.	Death.

This dog evidently died of heart failure. Intestines extremely congested throughout entire extent. In part the mucosa was hemorrhagic. Spleen dark blue. Pancreatic cannula clear. Pancreas showed no evidence of congestion. Right adrenal was grayish pink, shows hemorrhagic striation on section. Lungs normal. Heart flabby. Liver congested. Stomach and intestines empty, save for bile and possibly some chyme in lower part of small intestine.

EXPERIMENT 29, MARCH 16, 1910: LEFT ADRENAL REMOVED; SOME FLOW

		Blood pressure.
9.35 A.M.	Ether.	156
10.00 A.M.	L. A. O.	
10.20 A.M.	. . . . .	144
12.30 P.M.	. . . . .	113
	Fluid in cannula at 80 sucked out on account of blood-stain; blood-pressure pen slipped down on piston rod	138
4.01 P.M.	. . . . . First cannula full.	126
5.19 P.M.	. . . . . Second cannula full.	92
6.10 P.M.	. . . . . Third cannula full.	78
6.55 P.M.	. . . . . Fourth cannula full.	70
7.26 P.M.	. . . . . Fifth cannula full (95).	66
7.58 P.M.	. . . . . Sixth cannula full.	68
8.24 P.M.	. . . . . Seventh cannula full.	68
8.50 P.M.	. . . . . Eighth cannula full. (At 100 overfull).	clot
9.06.30 P.M.	. . . . . Ninth cannula full.	40
9.20 P.M.	. . . . . Cannula at 87th division.	Death.

Juice clear for at least three hours and flowing steadily and progressively slightly faster. It was very slow in morning. One hundred c.c. blood in abdomen, including a good-sized clot, evidently the site of the left adrenal. Retroperitoneal fat tissue shows hemorrhage into its substance. Liver shows some fatty and possibly some nutmeg appearance. Small clot in pancreatic duct which does not occlude duct or mouth of cannula. Pancreas normal in color. Intestines intensely hemorrhagic where handled. Stomach contains mucus and hair. Intestines full of a queer gruel-like mass, color of digested blood, which may be the gastric contents in part. Spleen moderately congested and smooth. Right adrenal shows area of hemorrhage on inside edge of cortex all around it.

EXPERIMENT 30, MARCH 17, 1910: LEFT ADRENAL REMOVED; NO FLOW

		Blood pressure.
At start.		170
10.26 A.M.	L. A. O.	
12.05 P.M.		120
2.26 P.M.		120
5.55 P.M.	. . . . . First cannula full.	106
7.05 P.M.		100
11.20 P.M.	. . . . . 87th division.	Death.

Dog's death at 11.20 hastened by ether. Only one cannula in thirteen hours. Bloody all day, however. Liver not congested. Spleen moderately so. Stomach and intestines empty, except for bile. Pancreas pale. Cannula clear below joint. Duct seems clear. Moderate amount of blood-stained fluid in abdomen. Right adrenal in better shape than most. But little injection around the cortex.

This dog was another instance of a practically normal dog which might have lived many hours yet.

EXPERIMENT 31, MARCH 28, 1910: LEFT ADRENAL REMOVED; BIG FLOW

		Blood pressure.
9.30 A.M.	Ether.	
9.42 A.M.	L. A. O.	174
11.33 A.M.	. . . . . Cannula 25th division.	150
12.37 P.M.		176
2.53 P.M.		164
3.34 P.M.	. . . . . First cannula full.	170
4.36 P.M.	. . . . . Second cannula full (97).	154
5.09 P.M.	. . . . . Third cannula full.	160
5.33 P.M.	. . . . . Fourth cannula full.	160
5.57 P.M.	. . . . . Fifth cannula full (overfull).	136
6.10 P.M.	. . . . . Sixth cannula full.	134
6.15 P.M.	. . . . . Seventh cannula full.	130
6.24 P.M.	. . . . . Eighth cannula full.	120
	6 min. 30 sec. later. Ninth cannula full.	clot
	5 min. 30 sec. later. Tenth cannula full.	clot
	5 min. 20 sec. later. Eleventh cannula full.	clot
	5 min. later. Twelfth cannula full.	clot
	Roll changed. Thirteenth cannula full.	clot
	5 min. later. Fourteenth cannula full.	clot
	5 min. 30 sec. later. Fifteenth cannula full.	clot
	7 min. later. Sixteenth cannula full.[1]	
7.18.30 P.M.	5 min. later. Seventeenth cannula full.	44
	2 min. 20 sec. later. Eighteenth cannula full.	44
	4 min. later. Nineteenth cannula full.	40
7.29 P.M.	4 min. later. 79th division.	Death.

[1] Loss of juice as cannula came out; loss of 20 divisions.

Small amount of blood-stained fluid in abdomen. Stomach and intestines not congested. Intestines contain small amount of yellow grumous material, which was possibly chyme. Stomach contains considerable quantity of green, muddy fluid. Spleen not congested, save for a few bullæ. Kidneys congested. Right adrenal very much congested, especially at junction of cortex and medulla. Lungs and heart normal.

Right adrenal, parathyroids and pituitary taken for sections.

EXPERIMENT 32, MARCH 29, 1910: LEFT ADRENAL REMOVED; NO FLOW

			Blood pressure.
9.30 A.M.	Ether.		130
10.00 A.M.	L. A. O.		
11.23 A.M.	. . . . .	No flow.	136
12.50 A.M.	. . . . .	No flow.	128
1.55 P.M.	. . . . .	No flow.	110
3.22 P.M.	. . . . .	No flow.	90
4.30 P.M.	. . . . .	No flow.	60
Death.			

Very little fluid in abdomen which pushed intestines into flank. Upper portion of duodenum very hemorrhagic. Intestines, in fact, very deeply congested throughout. Spleen very dark blue and covered with bullæ. No clot in duct. Liver congested; kidneys very much so. Stomach empty, except for air and some bloody, bile-stained mucus. Intestines empty, except for considerable blood. Right adrenal quite congested and blue, especially medulla. Cortex only slightly so. Left adrenal, removed in morning, also shows some cyanosis of the medulla. Heart very dilated and collapsed. Lungs normal.

GROUP 5.—RIGHT ADRENAL REMOVED.

EXPERIMENT 33, FEBRUARY 26, 1910: ATTEMPT TO CAUSE ABDOMINAL TRAUMA ANALOGOUS TO REMOVAL OF BOTH ADRENALS; NO FLOW

			Blood pressure.
9.05 A.M.	Ether.		
9.19 A.M.	R. A. O.		142
9.25 A.M.	. . . . .	Pancreatic cannula in place.	
	3 hr. 18 min. later.	First cannula full.	142
1.43 P.M.	1 hr. 7 min. later.	Second cannula full.	116
	34 min. later.	Third cannula full.	94
	39 min. later.	Fourth cannula full.	82
	About 5 minutes before last entry blood pressure fell to 42, probably from too much ether.		
	23 min. later.	Fifth cannula full.	58
	21 min. later.	Sixth cannula full.	56
	16 min. later.	Seventh cannula full.	46
4.05 P.M.:			
	12 min. 30 sec. later.	81st division.	Death.

Duct O. K. This dog gave a more than usually active flow at start. Spleen shows a few bullous patches; not especially congested. Liver slightly congested. Intestines very slightly congested and full of hemorrhagic ulcers in the upper part. Stomach contains considerable bile. Right adrenal was considerably torn in removal and was friable.

EXPERIMENT 34, MARCH 2, 1910: ONE ADRENAL OUT; EARLY DEATH; NO FLOW

		Blood pressure.
9.10 A.M.	Ether.	166
9.30 A.M.	R. A. O.	
9.51 A.M.		120
12.00 M.	2 hr. 6 min. later. Dog dies from sudden respiratory failure.	

EXPERIMENT 35, MARCH 3, 1910: ATTEMPT TO GET FLOW BY ABDOMINAL INJURY; NO FLOW

		Blood pressure.
9.49 A.M.		174
10.02 A.M.	R. A. O.	
10.10 A.M.		136
11.44 A.M.	First cannula full.	145
12.47 P.M.	Second cannula full.	145
1.39 P.M.	Third cannula full.	130
2.47 P.M.	Fourth cannula full.	120
3.56 P.M.	Fifth cannula full.	92
5.00 P.M.	Sixth cannula full (100).	94
6.04 P.M.	Seventh cannula full (105).	78
6.30 P.M.	Eighth cannula full (105).	44
7.27 P.M.	Ninth cannula full.	44
8.39 P.M.	Tenth cannula full.	40
9.15 P.M.	Cannula at 57th division.	Death.

Duct free. Stomach contains considerable yellow green fluid. Intestines empty. From about 2 inches below the pylorus to a point corresponding to the tail of the pancreas, the mucosa is raised in hemorrhagic patches, looking like ulcers (covered with mucus). Spleen not congested, but contains several bullous patches. Kidney and liver show small amount of fatty degeneration. Left adrenal at its larger end markedly hemorrhagic. Pancreas seems slightly congested, showing slight pinkish tinge in contrast to dead white color of fasting pancreas.

EXPERIMENT 36, MARCH 9, 1910: GOOD FLOW; RIGHT ADRENAL REMOVED; WORMS AND BLOOD IN INTESTINES

			Blood pressure.
9.30 A.M.			180
9.52 A.M.	R. A. O.		116
10.17 A.M.			106
	Juice running freely, no apparent cause for the fall in blood pressure.		
1.30 P.M.	. . . . .	First cannula full.	114
2.41 P.M.	. . . . .	Second cannula overfull.	clot
	10 min. later.		92
3.25 P.M.	. . . . .	Third cannula full.	72
4.01 P.M.	. . . . .	Fourth cannula full.	72
4.32 P.M.	. . . . .	Fifth cannula full.	60
4.58 P.M.	. . . . .	Sixth cannula full.	clot
5.25 P.M.	. . . . .	Seventh cannula full (100).	42
5.45 P.M.	. . . . .	Eighth cannula full.	38
6.00 P.M.	. . . . .	Ninth cannula full.	34
6.14 P.M.	. . . . .	Tenth cannula full.	30
6.26 P.M.	. . . . .	Eleventh cannula full.	28
6.36.30 P.M.	. . . . .	Twelfth cannula full.	24
6.46.45 P.M.	. . . . .	Thirteenth cannula full.	20
6.56.30 P.M.	. . . . .	Fourteenth cannula full.	clot
7.06 P.M.	. . . . .	Fifteenth cannula full.	20
7.12.30 P.M.	. . . . .	Sixteenth cannula full.	16
7.17 P.M.	. . . . .	Seventeenth cannula full.	Death.

This dog was very strong constitutionally and lived with blood pressure very low for several hours—longer in that state than the adrenal dogs do and almost as long as do the normal.

Small amount of blood-stained fluid in peritoneal cavity. Duct clear. Intestine full of uncinaria in great numbers, and partially digested blood (this may have increased flow). Mucosa looks somewhat roughened. Liver not congested. In intestines considerable blood-stained fluid and some bile; in lower intestines, much dark grumous blood. Spleen not congested; shows one bullous patch. Stomach distended with gas and contains a considerable amount of mucus and bile. Left adrenal looked normal on section.

Juice flowed fairly freely at the beginning of the experiment.

Group 6.—Abdominal Injury

Experiment 37, April 4, 1910: abdomen injured; adrenals intact; chyme in intestines

		Blood pressure.
9.05 A.M.	Ether.	
	Abdomen disturbed for control. Adrenals bluntly dissected, but left intact.	142
	Dog quite susceptible to ether.	
10.27 A.M.	. . . . . First cannula full.	148
	Juice flowing freely when cannula put in place at onset.	
10.56 A.M.	. . . . . Second cannula full.	130
11.28 A.M.	. . . . . Third cannula full.	148
12.00 M.	. . . . . Fourth cannula full.	156
12.33 P.M.	. . . . . Fifth cannula full.	142
1.00 P.M.	. . . . . Sixth cannula full.	138
1.26 P.M.	. . . . . Seventh cannula full.	136
1.49 P.M.	. . . . . Eighth cannula full.	136
2.15 P.M.	. . . . . Ninth cannula overfull.	142
2.31 P.M.	. . . . . Tenth cannula full.	142
2.48 P.M.	. . . . . Eleventh cannula full.	104
3.12 P.M.	. . . . . Twelfth cannula full.	clot
3.29 P.M.	. . . . . Thirteenth cannula full.	115
3.46 P.M.	. . . . . Fourteenth cannula overfull.	80[1]
4.00 P.M.	. . . . . Fifteenth cannula overfull.	70[1]
4.12 P.M.	. . . . . Sixteenth cannula overfull.	54[1]
4.22 P.M.	. . . . . Seventeenth cannula full.	54[1]
4.32 P.M.	. . . . . Eighteenth cannula full.	46[1]
4.41 P.M.	. . . . . Nineteenth cannula full.	44[1]
4.49 P.M.	. . . . . Twentieth cannula full.	42
4.57 P.M.	. . . . . Twenty-first cannula full.	74
5.06 P.M.	. . . . . Twenty-second cannula full (105).	72
5.12 P.M.	. . . . . Twenty-third cannula full.	52
5.18.30 P.M.	. . . . . Twenty-fourth cannula full.	50
7 min. 30 sec. later.	Twenty-fifth cannula full.	40
5 min. later.	Twenty-sixth cannula full.	26
1 min. 30 sec. later.	10 divisions.	Death.

Intestines contained chyme within a few inches of pylorus. It will be noticed that a flow existed in this dog from the start. Spleen mottled with dark blue areas. Liver not congested, yellowish. Intestines not congested. Stomach empty. Adrenals both congested and hemorrhages at junction of cortex and medulla.

[1] Blood pressure recording pen probably slipped down.

EXPERIMENT 38, APRIL 6, 1910: ABDOMINAL INJURY; ADRENALS BLUNTLY DISSECTED; NO FLOW

		Blood pressure.
9.32 A.M.	Ether.	
9.50 A.M.	Dissection finished.	134
12.09 P.M.	No cannula filled.	108
5.07 P.M.	No cannula filled.	110
7.02 P.M.	No cannula filled.	34

Duct clear. Pancreas and intestines pale rather than congested. Juice moved 11 divisions all day. Spleen contracted, hard, with a few dark blue patches. Liver not congested. Adrenals hemorrhagic between cortex and medulla. Stomach and intestines empty, save for bile. Heart and lungs normal, save that heart is somewhat flaccid.

Group 7.—Records of the Tests of the Various Secretin Preparations Against Each Other

EXPERIMENT 39: NORMAL SECRETIN VERSUS TERMINAL NORMAL SECRETIN.

December 30, 1909: T. N. S. made from experiment of December 29, 1909. (See Experiment 1.)

N. S.[1]	caused the filling of		4	cannulas and	45	divisions.[2]
T. N. S.	"	"	1	"	28	"
N. S.	"	"	4	"	32	"
T. N. S.	"	"	1	"		
N. S.	"	"	4	"	39	"
T. N. S.	"	"	1	"		
N. S.	"	"	3	"		

T. N. S. much weaker than N. S.

EXPERIMENT 40: NORMAL SECRETIN VERSUS TERMINAL NORMAL SECRETIN

January 4, 1910: T. N. S. made from experiment of January 3, 1910. (See Experiment 2.)

5 c.c.	N. S.	caused the filling of	1	cannula and	38	divisions.
5 c.c.	T. N. S.	" "	0	"	45	"
10 c.c.	N. S.	" "	2	cannulas	44	"

Dog died.

N. S. stronger than T. N. S.

[1] Where the quantity of secretin injected is not specified, inadvertently no record was taken of the amount at the time of the experiment, but it was always either 5 or 10 c.c., and was constant for any given comparison.

[2] It will be remembered that the cannulas used were marked off into 90 divisions each.

EXPERIMENT 41: NORMAL SECRETIN VERSUS TERMINAL NORMAL SECRETIN

January 5, 1910: T. N. S. made from experiment of January 3, 1910. (See Experiment 2); repetition of tests of January 4, 1910.

	N. S. Cannula stuck.					
	N. S. Accident to apparatus.					
10 c.c.	N. S. caused the filling of 3 cannulas.					
10 c.c.	T. N. S.	"	"	1	"	and 69 divisions.
10 c.c.	N. S.	"	"	2	"	44 "
10 c.c.	T. N. S.	"	"	1	"	48 "

N. S. stronger than T. N. S.

EXPERIMENT 42: NORMAL SECRETIN VERSUS TERMINAL ADRENAL SECRETIN

January 7, 1910: T. A. S. made from experiment of January 6, 1910. (See Experiment 10.)

7 c.c.	N. S. caused the filling of 2 cannulas and 48 divisions.					
5 c.c.	T. A. S.	"	"	3	"	70 "
5 c.c.	N. S.	"	"	0	"	72 "
5 c.c.	T. A. S.	"	"	1	"	83 "

T. A. S. stronger than N. S.

EXPERIMENT 43: NORMAL SECRETIN VERSUS TERMINAL ADRENAL SECRETIN

February 9, 1910: T. A. S. made from experiment of February 8, 1910. (See Experiment 15.)

5 c.c.	N. S. caused the filling of 12 cannulas and 30 divisions.					
5 c.c.	T. A. S.	"	"	10	"	78 "
5 c.c.	N. S.	"	"	6	"	65 "
5 c.c.	T. A. S.	"	"	4	"	40 "
5 c.c.	N. S.	"	"	4	"	70 "

N. S. stronger than T. A. S.

There was hemorrhage from the dog which gave T. A. S. This may have modified the activity.

EXPERIMENT 44: NORMAL SECRETIN VERSUS TERMINAL ADRENAL SECRETIN

January 12, 1910: T. A. S. made from experiment of January 11, 1910. (See Experiment 12.)

N. S. caused the filling of 3 cannulas and 25 divisions.					
T. A. S.	"	"	6	"	
N. S.	"	"	4	"	57 "
T. A. S.	"	"	5	"	37 "
N. S.	"	"	3	"	59 "
T. A. S.	"	"	5	"	83 "
N. S.	"	"	2	"	49 "

T. A. S. more active than N. S.

EXPERIMENT 45: NORMAL SECRETIN VERSUS TERMINAL ADRENAL SECRETIN

February 13, 1910: T. A. S. made from experiment of February 12, 1910. (See Experiment 16.)

5 c.c.	N. S.	caused the filling of	6	cannulas and	73	divisions.
5 c.c.	T. A. S.	" "	3	"	32	"
5 c.c.	N. S.	" "	3	"	54	"
5 c.c.	T. A. S.	" "	3	"	41	"
5 c.c.	N. S.	" "	2	"	40	"
5 c.c.	T. A. S.	" "	2	"	82	"
5 c.c.	N. S.	" "	2	"	52	"
5 c.c.	T. A. S.	" "	4	"	59	"
5 c.c.	N. S.	" "	1	"	62	"
5 c.c.	T. A. S.	" "	2	"	30	"

N. S. grows weaker; T. A. S. grows stronger.
Action eventually reversed.

EXPERIMENT 46: NORMAL SECRETIN VERSUS TERMINAL ADRENAL SECRETIN

February 14, 1910: T. A. S. made from experiment of February 12, 1910. (See Experiment 16.)

	N. S.	caused the filling of	1	cannula.	(Clot.)	
	T. A. S.	" "	3	cannulas and	70	divisions.
	N. S.	" "	1	"	75	"
	T. A. S.	" "	2	"	36	"
	N. S.	" "	1	"	79	"
	T. A. S.	" "	3	"		
	N. S.	" "	3	"	59	"
	T. A. S.	" "	2	"	48	"

T. A. S. stronger than N. S. in all but last pair of tests.

EXPERIMENT 47: NORMAL SECRETIN VERSUS TERMINAL ADRENAL SECRETIN

February 18, 1910: T. A. S. made from experiment of February 17, 1910. (See Experiment 17.)

5 c.c.	N. S.	caused the filling of	8	cannulas and	60	divisions.
5 c.c.	T. A. S.	" "	7	"	62	"
5 c.c.	N. S.	" "	8	"	68	"
5 c.c.	T. A. S.	" "	3	"	56	"
5 c.c.	N. S.	" "	6	"	74	"
5 c.c.	T. A. S.	" "	1	"	75	"

N. S. stronger than T. A. S. There was hemorrhage from the dog which gave the T. A. S. This may have modified the activity. Compare with Experiment 43.

EXPERIMENT 48: NORMAL SECRETIN VERSUS TERMINAL NORMAL SECRETIN

February 26, 1910: T. N. S. made February 25, 1910, from experiment of February 24, 1910. (See Experiment 4.)

5 c.c.	N. S.	caused the filling of	1	cannula	and	40	divisions.
5 c.c.	T. N. S.	" "	0	"		49	"
5 c.c.	N. S.	" "	1	"		49	"
5 c.c.	T. N. S.	" "	0	"		20	"
10 c.c.	N. S.	" "	3	"		31	"
10 c.c.	T. N. S.	" "	1	"		45	"

N. S. stronger than T. N. S.

EXPERIMENT 49: NORMAL SECRETIN VERSUS TERMINAL NORMAL SECRETIN

January 27, 1910: T. N. S. made from experiment of January 13, 1910. (See Experiment 3.)

	N. S.	caused the filling of	$4\frac{1}{5}$	cannulas.
	T. N. S.	" "	2	"
	N. S.	" "	$5\frac{1}{3}$	"
	T. N. S.	" "	$1\frac{1}{5}$	"
	N. S.	" "	$5\frac{1}{6}$	"
	T. N. S.	" "	1 +	"

N. S. shows decidedly greater activity than T. N. S.

Explanation of Charts

Fig. 1.—Tracing made February 8, 1910. from normal control, with adrenals intact showing fall of blood pressure in a lengthy experiment without flow. Ether begun at 9.53.

Fig. 2.—Tracing made December 15, 1909, from dog with adrenals removed; right adrenal removed 11.58 A.M., left adrenal removed 12.02 P.M.

Fig. 3.—Tracing from same experiment as Fig. 2, showing rate of flow at 5.48 P.M. and covering the filling of one cannula.

Fig. 4.—Tracing from same experiment as Figs. 2 and 3, showing rate of flow at 7.04 P.M.

Fig. 5.—Tracing made February 17, 1910, from experiment on animal with adrenals removed. Right adrenal removed 10 A.M., left adrenal at 10.32 A.M.; showing flow of juice, with a high blood pressure. In this tracing, inadvertently, no record was taken of the flow at the periods shown in the segment. The flow appears on the next two tracings.

Fig. 6.—Tracings from same experiment as Fig. 5, showing flow of juice with a fairly high blood pressure at 1.38 P.M.

Fig. 7.—Tracing from same experiment as Figs. 5 and 6, showing flow of juice, with a fairly high pressure at 2.05 P.M.

Note.—The zero of blood pressure was always set at $1\frac{1}{2}$ cm. above the base line to avoid interference of the writing pens.

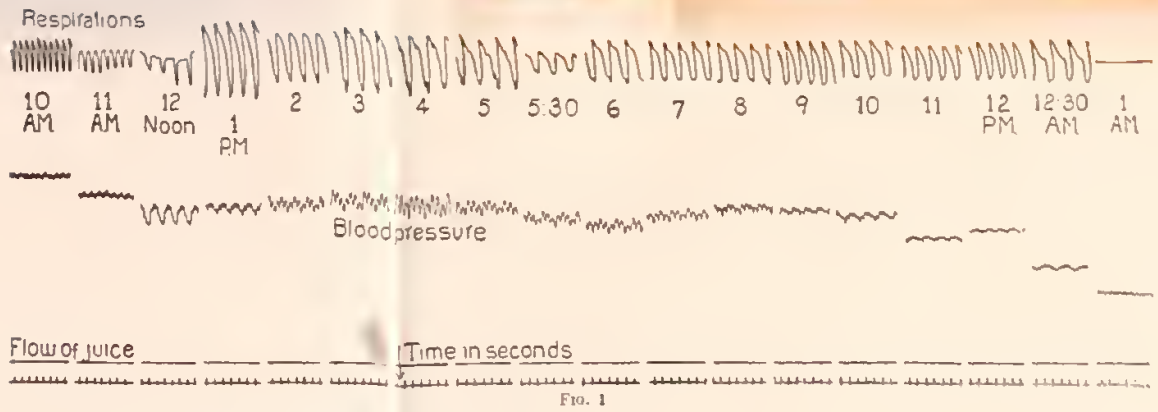


Fig. 1

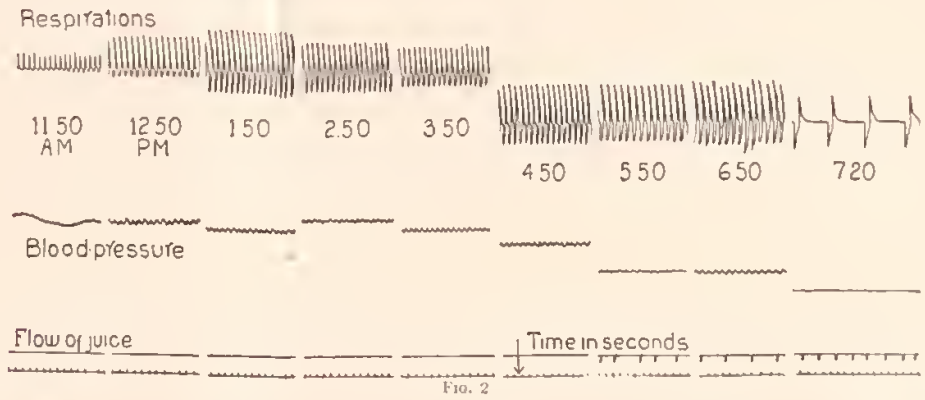


Fig. 2

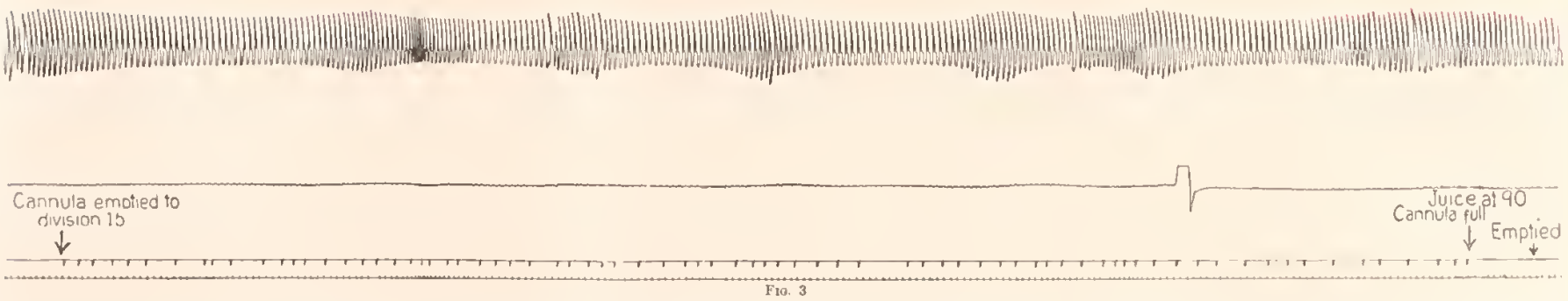


Fig. 3

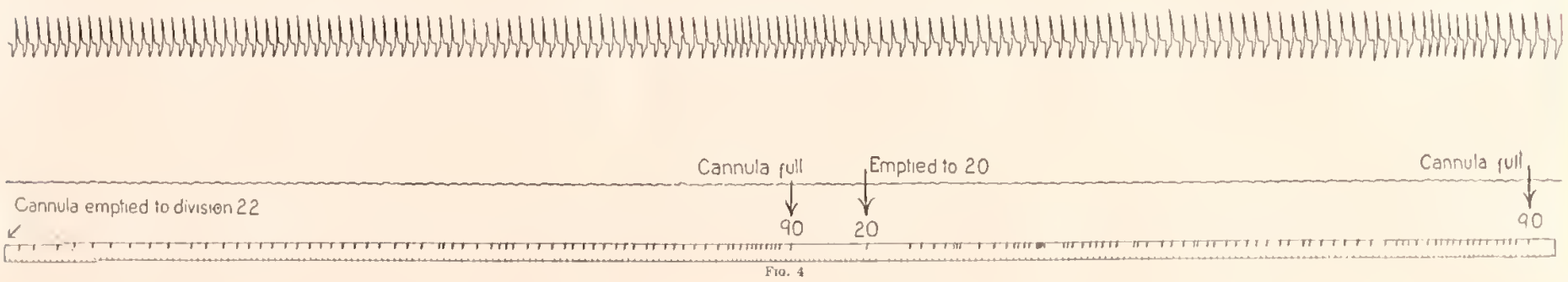


Fig. 4

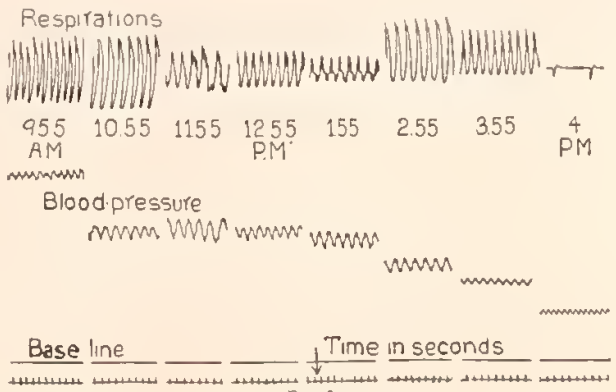


Fig. 5

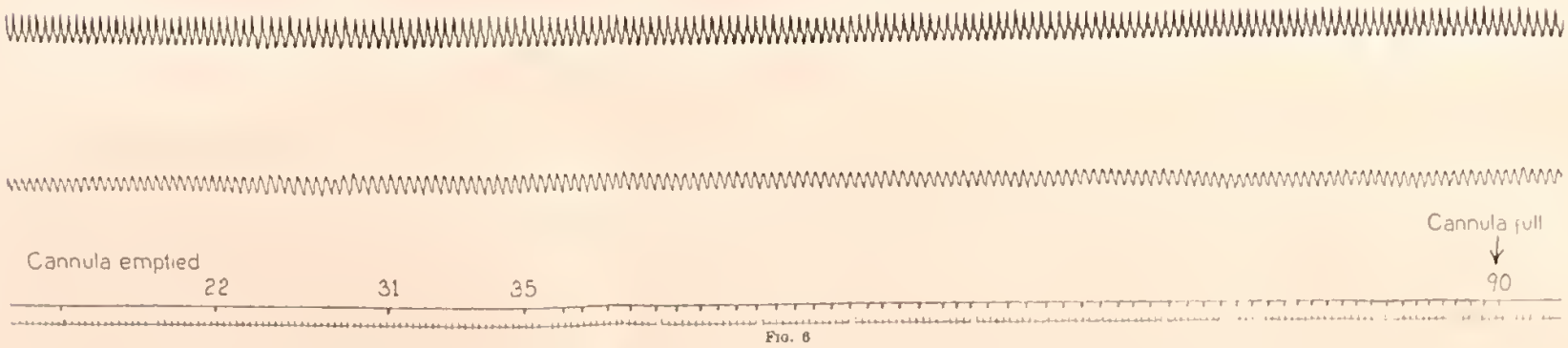


Fig. 6

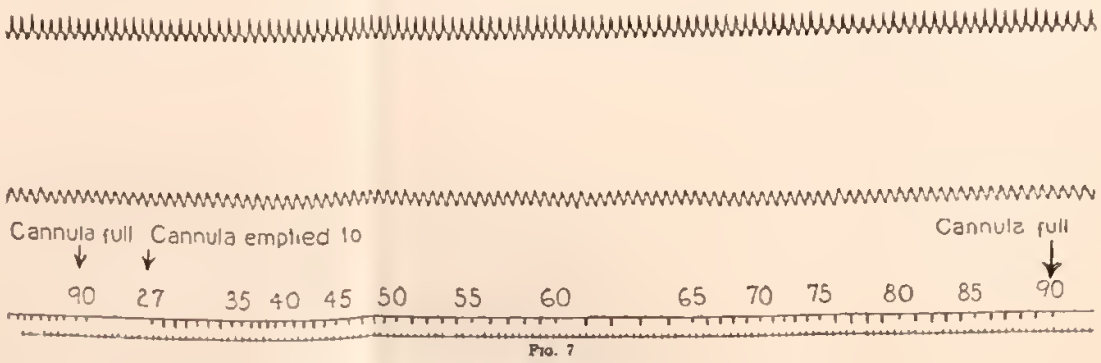


Fig. 7

DISCUSSION

Dr. Hobart A. Hare: When a good piece of original work is done there is often nothing that we can discuss because the field is new. It is not lack of appreciation, but lack of knowledge upon this subject which prevents us from speaking.

Dr. G. E. de Schweinitz: The chair is unable to discuss this paper, but desires to express his high appreciation of it, and is sure the College joins with him in this expression. It is a matter of gratification that the record of this interesting and important research has been made first in this hall.

MENINGITIS AND DISEASE OF THE RADICULAR NERVES IN TABES DORSALIS*

By JOHN H. W. RHEIN, M.D.,
NEUROLOGIST TO THE HOWARD HOSPITAL, ETC.

(From the Philadelphia Home for Incurables, the Philadelphia General Hospital, and the Department of Neurology and the Neuropathological Laboratory of the University of Pennsylvania)

The changes in the radicular nerves in tabes, the relation that meningitis bears to this disease, the character of the meningitis, its relation to syphilis, and the part the meningitis plays in the causation of the radicular nerve changes, are all questions that have been discussed at length in the literature without, however, having been definitely answered.

With a view to throwing some light upon this subject an opportunity was offered me, through the courtesy of Dr. William G. Spiller and others, to study the available material at the Laboratory of Neuropathology of the University of Pennsylvania, which, with my own cases, consisted of the spinal meninges of seventeen cases of tabes dorsalis, the cortical meninges of sixteen of these, and the radicular nerves of eight cases of tabes and one of syphilis of the nervous system.

Twenty-five radicular nerves from eight cases were cut in serial sections and stained by hematoxylin and acid fuchsin, and by the Weigert method. Of these cases nine have already been reported, although not in this relation.

Case I.—M. M., aged sixty-six years, history of syphilis thirty-five years previously. First symptom twenty-five years before death. Argyll-Robertson pupil; pains in the legs; knee-jerks absent; Romberg's symptom marked.

* Read March 10, 1910.

Typical tabetic degeneration of the posterior columns, slight in degree. Slight border degeneration. Degeneration of the anterior and posterior roots. Intense round-cell infiltration of the pia. The bloodvessels of the pia were thickened, the lumen narrowed, and in places intense proliferation of the inner coat of the bloodvessels was present. The infiltration of the pia showed no predilection. The round-cell infiltration was typically specific in appearance. The pia of the paracentral region was thickened and infiltrated with connective-tissue cells.

Case II.—F. K., aged forty-eight years. Family and previous histories negative. Venereal history denied. Symptoms of four years' duration consisting of lancinating pains, Romberg's symptom, failure of eyesight, trophic ulcers of the plantar surface of the feet, absent knee-jerks and other tendon reflexes of the legs; double ptosis; some slight sensory changes and Charcot's joint. The pupils responded to light and in accommodation. There was wasting of the thenar and hypothenar eminences and the dorsal interossei of both hands.

There was typical tabetic degeneration in the posterior columns, moderate in degree, and very slight in the cervical region. Both anterior and posterior roots were degenerated. There was a well-marked round-cell infiltration of the pia, and slight thickening of the vessel walls. The infiltration was not more marked anywhere excepting in the pia of the anterior longitudinal fissure. The pia of the paracentral region showed infiltration of connective-tissue cells and plasma cells. Little or no bloodvessel disease was demonstrated, although one vessel was obliterated.

Case III (reported by Carl D. Camp, M.D., *University of Penna. Med. Bulletin*, January, 1905).—W. H., aged forty-seven years. Specific infection denied. Ataxic symptoms for eight years. Ataxic station and gait; absent knee-jerks; incontinence of urine; Argyll-Robertson pupil; sensory disturbancesf atrophy of the muscles of the lower extremities, and wasting of the muscles o; the arms.

There was advanced degeneration of the posterior columns. Very slight round-cell infiltration of the pia of the cervical and thoracic regions. The pia in the paracentral region was profoundly infiltrated with connective-tissue cells, and thickened. There was no perceptible bloodvessel disease.

Case IV (reported by Cohen and Spiller, in *American Journ. of Med. Sciences*, 1901, No. 122, p. 170).—Man, aged sixty-seven years, with a history of syphilis. The symptoms were nocturnal incontinence of urine; ptosis of the right eyelid; difficulty in mastication and deglutition; atrophy of the tongue; sensory disturbances; lancinating pains; inequality of the pupils, and loss of reaction to light and accommodation. Atrophy of the upper limbs. No ataxia of the legs. Knee-jerks preserved. A diagnosis was made of cervical and bulbar tabes.

There was degeneration of the posterior roots of the spinal cord in the middle and upper thoracic regions on the right side, and in the lower cervical region, but hardly perceptible in the lumbar and lower thoracic regions. There was very slight degeneration of the columns of Burdock in the upper thoracic and cervical regions. Atrophy of the inferior part of the left twelfth nucleus was present. Intense degeneration of the left descending root of the ninth and tenth nerves. Degeneration of the seventh and sixth, the spinal root of the fifth, and atrophy of the nuclei of the oculomotor nerves.

Examination of the meninges from the thoracic and lumbar regions made by myself in this case showed round-cell infiltration of the pia, lymphoid and connective-tissue in type, mainly the latter. This seemed to be general and showed no predilection as to position. There was some perivascular round-cell infiltration of mononuclear type. The bloodvessels were not thickened. The pia from the paracentral region was slightly thickened and infiltrated with connective-tissue cells. No vascular disease was observed.

Case V (reported by C. D. Camp, M.D., *University of Penna. Med. Bulletin*, January, 1905).—J. A., aged fifty-five years. Symptoms of six years' duration. Romberg's symptom; Argyll-Robertson pupil; ataxia of the arms and legs; no atrophy; absence of knee-jerks; lancinating pains and sensory disturbances. Besides intense lesions of tabes there was degeneration in the posterior part of each lateral column, Camp thought, of vascular origin.

My own examination of these specimens showed, besides a slight border degeneration, round-cell infiltration of the pia, which, however, was so slight as not to be pathological. The pia of the paracentral region was slightly thickened, and markedly infiltrated with connective-tissue cells and some polynuclear lymphocytes. The bloodvessels were thickened as were also the walls of the bloodvessels in the pia of the cord.

Case VI (case of Dr. C. H. Potts).—M., aged fifty years. Syphilitic history. Ataxia of eight years' duration; Romberg's sign; absent knee-jerks; Argyll-Robertson pupil; gastric crises.

Intense tabetic degeneration of the posterior columns. Slight degeneration of the anterior roots, and marked degeneration of the posterior roots. The pia was thickened and intensely infiltrated with round cells, slightly more marked around the anterior and posterior portions of the cord. Perivascular infiltration was present. The bloodvessel walls were thickened, the lumen narrowed, and obliterative endarteritis was observed. The pia of the paracentral region was much thickened, and markedly infiltrated with connective-tissue cells. The bloodvessel walls were thickened.

Case VII (reported by S. Leopold, M.D., *Jour. Nerv. and Ment. Disease*, 1909).—G. W., aged fifty-four years. History of syphilis not obtained. The symptoms consisted in the main of ataxia, lancinating pains, loss of the Achilles-

tendon reflex; vesical and rectal symptoms; myosis; preserved patellar reflexes; ataxia in both legs.

Degeneration of the posterior root zone was pronounced through all the sacral segments, and extended as high as the fourth lumbar segment. In the middle thoracic and lower cervical segments only degeneration of the columns of Goll was observed. The degeneration was more pronounced on the right side, involving the posterior root zone from the fourth lumbar segment down to the eighth.

Dr. Leopold kindly permitted me to study his sections. The pia of the cord in the cervical region was thickened and the seat of a slight round-cell infiltration, principally perivascular and showing no predilection as to position. In the lumbar region the pia was intensely infiltrated on one side, where the degeneration in the posterior columns was most intense. The bloodvessels showed slight round-cell infiltration of the inner walls. The posterior roots were degenerated, the anterior roots intact. In the sacral region the pia was thickened, but there was only slight round-cell infiltration. The cells consisted in part of mononuclear lymphoid round cells, but mainly of connective-tissue cells.

Case VIII (reported by Dr. Paul H. Bickle, *Medical Record*, May 8, 1909).—J. P., aged thirty-nine years. Family history negative. He had been excessive in the use of alcohol, and gave a history of syphilis. The symptoms were of seven years' duration, and consisted of lancinating pains in the limbs, ataxic gait, sphincter disorders, irregular pupils, the right reacting feebly to light, the left not at all, both reacting to convergence and in accommodation; tendon reflexes absent, inability to stand or walk, and sensory disturbances.

Advanced typical tabetic degeneration in the posterior columns extending the entire length of the cord was present. The anterior roots were preserved in the cervical, thoracic, and lumbar regions. The posterior roots, however, were markedly degenerated. The pia in the cord was thickened and infiltrated with mononuclear cells, mainly of connective-tissue type. The round-cell infiltration was moderate in extent, but marked in degree. The bloodvessels were thickened in places, and the intima in some was proliferated. There was no predilection as to position observed in the meningeal infiltration, except around the posterior roots where the bloodvessels were more numerous. The pia from the paracentral region was thickened and fibrous, and moderately infiltrated with connective-tissue cells.

Case IX (reported by John H. W. Rhein, M.D., *Jour. of Amer. Med. Assoc.*, February, 1905).—Male, aged fifty-seven years. Family and previous histories negative except for a history of syphilis. The symptoms were Romberg's symptom; absent knee-jerks; sensory phenomena; incontinence of urine and Argyll-Robertson pupils. There was also present a tremor resembling that of paralysis agitans.

Pathologically typical tabetic degeneration of the posterior columns was demonstrated. The posterior roots were degenerated at all levels. The anterior roots were intact. The pia of the spinal cord was thickened, and the seat of moderate round-cell infiltration more marked in the midthoracic region than in the thoracic and lumbar regions. The cells were of the connective-tissue type, and showed no predilection as to position. The cells were also of mononuclear type, with deeply staining nuclei resembling mononuclear leukocytes. The infiltration resembled that of syphilis. In the lumbar region the bloodvessels were thickened, and in some places the lumen was almost obliterated. The pia from the occipital and frontal regions was markedly infiltrated with cells of connective-tissue type, and mononuclear cells with deeply staining nuclei, probably specific in type.

Case X.—J. B., aged sixty-seven years. Family and previous histories negative. Syphilis denied. The symptoms began four years previously, with sudden attack of paralysis of the left side of the face. On examination he was markedly ataxic; Romberg's symptom was present; the pupils were contracted, reacting to light and in accommodation; sensation was disturbed and the tendon reflexes were absent. The left nasolabial fold was deeper than the right, and the left eyelid drooped. He was generally wasted, especially in the forearms.

The pia of the spinal cord was infiltrated with cells, the nuclei of which stained deeply. The bloodvessels showed proliferation of the intima, and the lumen was narrowed. The round-cell infiltration generally showed no predilection for position, although in the sacral region it was slightly more pronounced anteriorly and posteriorly. The degeneration of the posterior columns was very pronounced throughout the entire cord.

One radicular nerve, including the ganglion, was studied. Round-cell infiltration of the endo- and perineurium was demonstrated throughout the entire radicular nerve, and extending as far as the ganglion. There was only slight degeneration observed by the Weigert method. The bloodvessels of the radicular nerves showed round-cell infiltration of the walls. This was also present in the meninges, but was more marked in the radicular nerves. The pia of the paracentral region was thickened and infiltrated with large connective-tissue cells.

Case XI.—A. M., aged fifty-two years. First symptoms began twenty-three years before death. Upon examination there were Argyll-Robertson pupil, absent knee-jerks, marked ataxia, Romberg's symptom, and sensory phenomena. There were also marked spasticity of the arms and legs, a coarse tremor of both arms and legs, some wasting, and gastric crises.

Study of the spinal cord showed advanced tabetic degeneration throughout. There was marked round-cell infiltration in the meninges and anterior and posterior roots. The bloodvessels were very much thickened and there was perivascular round-cell infiltration. Gowers' tracts were degenerated in the

cervical region, and also the direct cerebellar tracts, and border degeneration was present. In the thoracic region the posterior degeneration was intense, and the remainder of the white matter was diffusely involved, there being marked border degeneration, but no tendency to any systemic involvement. The degeneration of the white matter outside the posterior columns was evidently secondary to specific foci. In the posterior columns it was typically tabetic. The pia of the paracentral region showed marked thickening, and was infiltrated with connective-tissue type of cells, and with mononuclear, and occasionally polynuclear, cells. The bloodvessels were thickened.

Four radicular nerves, including the ganglia, were studied. In one of these there was degeneration of the fibers at the ganglion which became more marked centralward, with marked round-cell infiltration of the perineurium, together with epi- and endoneuritis, which grew more intense centralward. In another nerve studied the fibers stained well at the ganglion, where no infiltration was observed, though the perineurium was thickened. Centralward there was round-cell infiltration in the epineurium and endoneurium, and the degeneration was marked by the Weigert method. In the third radicular nerve studied no round-cell infiltration at the ganglion was seen. Slightly centralward there was moderate degeneration of the posterior roots, but no round-cell infiltration. More centralward there was marked round-cell infiltration of the endo- and epineurium. Hemorrhagic softening of the posterior roots and intense degeneration (Weigert method) was observed, the anterior roots being intact. There was no perineuritis at this level. In the fourth radicular nerve the anterior and posterior roots coming from the ganglion were intact. The perineurium was thickened, but there was no round-cell infiltration. More centralward the epineurium was implicated, but the nerves showed no round-cell infiltration. The anterior roots of three of these radicular nerves were intact. This was a case of tabes complicated by cerebrospinal syphilis.

Case XII.—M. B., aged fifty-three years. Family and previous histories negative. Symptoms began three years previously with weakness in the left leg, but this gave her very little trouble until a year later, when she fell and struck her knee on the curbstone. Since then it has been swollen, but not painful, though after wearing a stocking the swelling improved, but at the same time the left foot became swollen and painful.

On examination the patient showed absent reflexes; Argyll-Robertson pupil, the left pupil slightly larger than the right; some sensory disturbances; slight diminution in power in the left leg, but otherwise good power in all the muscles. (Further the notes do not go.) The symptoms were over three years in duration.

The cord presented the typical appearance of tabetic degeneration. In the cervical region the degeneration was very slight and diffuse, was only moderate in the lumbar region, and less marked in the thoracic region. The pia in

the cervical region showed considerable round-cell infiltration, though not excessive. The bloodvessels were somewhat thickened. The infiltration showed no preference as to situation. Border degeneration was present in the thoracic region. The infiltration consisted of large round mononuclear and connective-tissue cells. The process was more marked at the entrance of the roots where the bloodvessels were intensely involved. The arteries were thickened and there was perivascular round-cell infiltration and some round-cell infiltration of the outer walls of the veins, though this process was not marked. Examination of the pia in the paracentral region showed a slight round-cell infiltration of connective-tissue type. The pia was thickened, but no bloodvessel disease was demonstrated.

Five radicular nerves were studied, in three of which the ganglia were included. In the first the posterior roots were markedly degenerated, the anterior roots only slightly so. No round-cell infiltration was observed. More centralward there was an area of softening in the posterior roots, evidently hemorrhagic in character, much blood pigment being present. The posterior roots were intensely degenerated throughout the entire radicular nerve, while the anterior roots showed no degeneration to speak of. In a second nerve the fibers stained well at the ganglia, and there was slight round-cell infiltration of the epi- and endoneurium, and slight degeneration more centralward by the Weigert method.

In a third nerve near the ganglion there was no round-cell infiltration nor degeneration of the roots. A little more centralward there was intense round-cell infiltration of the epineurium, near which could be seen destruction of the fibers and accumulation of round cells. By the Weigert method there was observed slight border degeneration of the posterior roots, the anterior roots being intact. Still further centralward there was slight degeneration of one portion of the posterior roots, the anterior roots being intact. There was intense round-cell infiltration of the epi- and endoneurium around the posterior roots. Further centralward the anterior and posterior roots showed no degeneration whatever.

In still another nerve there was degeneration of the nerves and round-cell infiltration involving the endo- and epineurium. In a fifth nerve degeneration of the fibers could be seen coming from the ganglia in the posterior roots. The anterior roots were not degenerated. More centralward there was intense degeneration of the posterior roots, but only a slight round-cell infiltration of the perineurium. There was no epi- or endoneuritis. This did not show the typical Nageotte degeneration. The round-cell infiltration was of the connective-tissue type. The bloodvessels were diseased in the radicular nerve, showing narrowed lumen. Infiltration was less marked in the radicular nerve than in the meninges.

Case XIII.—T. O'M., aged forty-three years. Family and previous histories negative. Patient was admitted with symptoms of advanced tabes, the first symptoms beginning over seven years ago. He was unable to walk for a year before his death. Characteristic lancinating pains were present, also ataxic gait: Romberg's symptom; absent knee-jerks; unequal pupils reacting sluggishly to light and readily to accommodation, and later Argyll-Robertson pupil. The patient became unruly toward the last of his life, and finally died of tuberculosis of the lungs at the age of forty-three years.

The spinal cord showed advanced tabetic degeneration. The pia was the seat of a marked round-cell infiltration, slightly more marked around the anterior and posterior portions of the cord. There was some thickening of the walls of the vessel, the vessel lumen was narrowed, and the walls infiltrated with round cells. The veins showed infiltration of the outer walls in places. The anterior roots were intact, while the posterior roots showed marked degeneration and infiltration with round cells. There was border degeneration of the cord. There was a slight hemorrhage into the pons in the pyramidal tracts, apparently recent. There was evidently a syphilitic meningitis, with the typical bloodvessel disease found in this condition. Examination of the pia of the paracentral region showed thickening, vascular disease, and round-cell infiltration of connective-tissue type.

Six radicular nerves were examined, four of which included the ganglia. In one of the nerves there was slight degeneration by the Weigert method observed at the ganglion, without round-cell infiltration. More centralward there was observed slight degeneration in the posterior roots (Weigert), but no round-cell infiltration whatever. In the second nerve the posterior roots were markedly, the anterior roots slightly, degenerated. There was some perineural involves ment, but no epi- or endoneuritis. The perineurium was thickened, but no round-cell infiltration was observed.

In the third radicular nerve studied the posterior root was intensely degenerated just as it left the ganglion, but there was no evidence of round-cell infiltration. In the perineurium there was slight infiltration. The anterior roots were intact. Centralward the round-cell infiltration of the perineurium was marked, and the epineurium was implicated, and this later involved both the anterior and posterior roots, when the endoneurium was diseased. The fourth radicular nerve showed no round-cell infiltration or degeneration of the roots. There was not very much of this root obtained and studied, and it was probably one of the dorsal roots.

In the fifth nerve there was no round-cell infiltration, though slight degeneration of the posterior roots by the Weigert method was observed. Otherwise the nerve stained well. In the sixth nerve the posterior roots were degenerated near the ganglion, but there was no round-cell infiltration. More centralward there was round-cell infiltration of the endo- and epineurium, and the posterior roots were found degenerated.

Case XIV.—H. G., aged sixty-five years. Family and previous histories negative. The symptoms were absent reflexes, sphincter involvement, lancinating pains, ataxia in the arms and legs, lost tendon reflexes in the legs, Romberg's sign, irregular pupils reacting to accommodation and sluggishly to light.

In the cervical region of the cord the anterior and posterior roots were intact, and the posterior columns were only slightly involved. In the thoracic region there was a border degeneration and degeneration confined to the middle and dorsal root zones in the lateral portion. The posterior roots were slightly degenerated; the anterior roots remained intact. There was only slight involvement of the central root zone. There was no infiltration of the pia in the cervical region, though it was thickened, and this was true of the other levels of the cord. The bloodvessels were thickened, and some round-cell infiltration of the veins was observed. A small hemorrhage was found in the gray matter of the cortex. The pia of the cortex was thickened, and there was a sparse round-cell infiltration of connective-tissue type.

Four radicular nerves were studied, in one of which the ganglion was present. In the first nerve the anterior roots were intact, but the posterior roots showed intense degeneration. There was a hemorrhagic area of softening in the posterior roots, and the perineurium around the posterior roots was slightly infiltrated. More centralward there was some endoneuritis, but no round-cell infiltration of the endoneurium at this place. Still more centralward the epineurium was infiltrated, giving rise to degeneration of the fibers near the cell infiltration. Still more centralward the anterior roots were found slightly degenerated, which later became marked. In the second nerve studied the endoneuritis was intense, while the fibers stained fairly well by the Weigert method in the posterior roots, the anterior roots probably being intact. There was slight epineuritis, but no involvement of the nerve bundles. More centralward endoneuritis was observed without degeneration. Later there was intense degeneration of the fibers with marked round-cell infiltration.

In the third radicular nerve studied there was, near the ganglion, no degeneration by Weigert, and no peri-, epi-, or endoneuritis. More centralward, however, slight degeneration of the posterior roots was observed, while the anterior roots were intact. Perineuritis and round-cell infiltration were observed without epi- or endoneuritis; then, more centralward, there was slight degeneration of the posterior roots, with the anterior roots intact. Still further centralward there was intense degeneration of the posterior roots, and hemorrhage into the posterior roots with marked endoneuritis was present, though no epineuritis, but some perineuritis, showing that endoneuritis may exist without epineuritis. Finally, there was space formation, that is to say, softening due to hemorrhage into the nerve.

In the fourth nerve examined there was found posterior-root degeneration

without round-cell infiltration of the epi- or endoneurium. More centralward there was observed degeneration of the anterior and posterior roots, more marked in the latter, without peri-, epi-, or endoneuritis. Still nearer the centre there was endoneuritis with round-cell infiltration of the posterior roots, without destruction of the nerve elements, however. There was slight perineuritis, but no epineuritis. Later the perineuritis became intense. The bloodvessels were not markedly diseased, though there was some hyaline degeneration of the walls.

In this case there was no marked round-cell infiltration of the meninges or radicular nerves. The cells in the radicular nerves, and the round-cell infiltraion which was present, showed connective-tissue cells especially, though there were some lymphoid cells as well.

Case XV (reported by Spiller, Syringomyelia and Tabes, *Journal of Med. Research*, March, 1908, vol. xviii).—J. S., aged sixty years. No history of syphilis. Romberg's symptom, lancinating pains, ataxia of the hands, sensory disturbances, atrophy of the thenar and hypothenar eminences of the hands, lost reflexes in the arms and legs, Babinski on both sides, pupils reacting sluggishly to light, and promptly to convergence and accommodation, constituted the main symptoms. The symptoms were of thirty-one years' duration. Examination of the cord showed typical degeneration of tabes, associated with syringomyelia. The pia showed infiltration of cells of the connective-tissue type, the infiltration being evenly distributed, and not more intense around the roots. The veins showed round-cell infiltration of the walls, more pronounced around the syringomyelic areas. The arteries appeared to be intact. The round cells consisted of the proliferative type of connective-tissue cells. Examination of the pia in the paracentral region showed thickening of the pia with slight round-cell infiltration of connective-tissue type.

Two radicular nerves, including one ganglion, were examined. The anterior and posterior roots were both degenerated slightly at the ganglion, the degeneration of the posterior roots becoming more intense centralward. There was no round-cell infiltration at the ganglia. More centralward the perineurium was involved, with slight round-cell infiltration, but no true implication of the endoneurium was noted. Nearer the centre still, however, the round-cell infiltration invaded the endoneurium in the posterior roots, but not in the anterior roots. There was also epi- and perineuritis. In the second radicular nerve studied the conclusions were not very definite. There was slight degeneration of the anterior and posterior roots, but no round-cell infiltration.

The bloodvessels in the radicular nerves were not diseased, and the round-cell infiltration was slightly more intense than in the meninges, though intense in both places. The round cells were of the proliferative connective-tissue type.

Case XVI.—S., admitted to the Philadelphia Home for Incurables, March 12, 1900. Family and previous histories negative. Lancinating pains; Argyll-Robertson pupil; absent knee-jerks; Charcot's joint; incontinence of urine; sensory disturbances; bedfast.

Typical advanced degeneration of the posterior columns, more marked in the sacral and lumbar regions. The anterior roots were slightly degenerated; the posterior roots markedly so. The pia was uniformly thickened at all levels of the cord studied, but there was no round-cell infiltration anywhere. The bloodvessels were thickened, but did not show any infiltration of the walls. The pia of the paracentral region was thickened and moderately infiltrated with round cells of the connective-tissue type. The bloodvessels were thickened, but the walls showed no cellular infiltration.

Study of the radicular nerve of the tenth thoracic vertebra of the sensory root showed degeneration by the Weigert method, extending as far as the ganglia, but there was no round-cell infiltration. The motor portion of the root was intact.

Case XVII.—S., admitted to the Philadelphia Home for Incurables with a diagnosis of locomotor ataxia. No history of this case could be found on the records, and the symptoms were not recorded.

Pathologically the following conditions were found: Typical tabetic degeneration of the posterior columns; degeneration in the posterior roots, and slight degeneration in the anterior roots. The pia was thickened throughout the cord, but no round-cell infiltration was found. The bloodvessels were thickened slightly, but there was no infiltration of the walls. The pia of the paracentral region was thickened and moderately infiltrated with connective-tissue cells. The bloodvessels were thickened, but the walls were not infiltrated.

Two radicular nerves were studied; in one, transverse sections, and in the other longitudinal sections were made. In both of these roots by the Weigert stain there was intense degeneration extending as far as the ganglion, but nowhere could be seen any round-cell infiltration except in the perineurium, where there was slight round-cell infiltration only. This did not extend to any of the other coverings of the nerve, however, at any level studied, and these roots did not present the appearance described by Nageotte. The sensory root was alone degenerated, the motor root staining well.

Case XVIII.—Case of cerebrospinal syphilis. T. L., aged fifty-four years, was admitted to the Philadelphia General Hospital, February 4, 1901. The family and previous histories were negative. There was no history of syphilis. Two years previous to admission, following an attack of unconsciousness, there was weakness of the legs which progressed to total paralysis over several months. There was then some return of power which failed in the six weeks before admission. His hearing was impaired for five or six years, but twenty months previous to admission he became very deaf in one week's time. He

was subject to attacks of unconsciousness of one minute duration, beginning with vertigo, and he suffered from intermittent headaches for two years. Vision was affected since the first attack of unconsciousness. There was a history of diplopia.

The symptoms consisted in wasting of the legs, especially the thighs; weakness of both legs and a sense of numbness in the legs with lowered sensation to pain and heat.

Knee-jerks were absent on both sides; the Babinski phenomenon was present on both sides; the biceps-jerks in the arm were present, and the triceps-jerk absent on both sides. There was no ataxia in the arms. The pupils reacted slowly to light and accommodation.

When examined by Dr. Spiller, on June 10, 1901, four months later, the atrophy of the lower limbs was very marked. Power was retained in all muscles, but diminished. The knee-jerks were entirely lost on both sides. There was no ankle-jerk on either side. The plantar and cutaneous reflexes were exaggerated on both sides. Tactile sense was present everywhere. Pinpoint was very sharply felt, and probably hyperesthetic. There was fairly good motor power in the upper limbs which were not much atrophied. The dynamometer registered on the right twenty-two; on the left thirty-eight.

Upon voluntary motion of the upper limbs a fine tremor was observed, probably the result of weakness. The interossei muscles were probably atrophied. The pupils were unequal, the right smaller than the left, and irregular in outline, and contracted to light, but the action was slow. Contraction in convergence was very prompt. Station was very uncertain, but he was able to stand with the feet wide apart. The urine and feces were incontinent.

Examination by Dr. Pierce on April 13, 1901, showed reactions of degeneration in the anterior tibial group of muscles, and in the gastrocnemic group in the right leg. Examination of the eyes by Dr. Hansel showed exophthalmos; a tendency to divergence with slow droop of the lid on downward movement of the eyeball; complete movements of the eyeballs, and clear media.

The spinal cord in the cervical region showed degeneration of the anterior and posterior roots, being more intense in the latter. There was, however, no degeneration in the intramedullary portion of these roots. Border degeneration was present, especially in the posterior columns around the most posterior portion of the longitudinal fissure. The posterior columns were diffusely degenerated in the posteromedian portions of both sides, but not resembling in any way a tabetic lesion. There was present a widespread perivascular round-cell infiltration throughout the white matter of the entire cord, especially adjacent to the pial indentations. Round-cell infiltration of the walls of the vessels of the pia and of the roots, and around the roots, was observed. Practically the same condition was found in the thoracic region and in the lumbar region. The border degeneration in the lumbar cord was principally lateral,

the posterior columns being slightly involved, if at all. The anterior and posterior roots were markedly degenerated. The round-cell infiltration consisted of mononuclear cells, as well as cells of the connective-tissue type.

Four radicular nerves were studied, in one of which the ganglion was included. There was peri- and endoneuritis present in one root, without any degeneration demonstrable by the Weigert method. In a second nerve there was degeneration by the Weigert method, but it was very slight and entirely out of proportion to the degree of cellular infiltration.

In the third nerve the perineuritis was marked, while the round-cell infiltration of the connective tissue within the bundles was slight. The perineuritis was marked in the posterior roots, and involved the endoneurium. The axis cylinders were swollen, but did not show degeneration by Weigert. The epineurium was markedly infiltrated. A little further away from the ganglion there was degeneration in the posterior roots by the Weigert method, and still further away some fasciculi, and some parts of other fasciculi in the posterior roots showed some degeneration. This was also present in the anterior roots, but was less marked. The degeneration in the fasciculi, studied by the Weigert method, did not seem at all in proportion to the degree of round-cell infiltration of the covering of the nerve bundles. Still farther away from the ganglion there was marked peri- and endoneuritis, with preservation of the fibers, as seen by the Weigert method, except one bundle which was greatly degenerated, strongly contrasting with the healthy fibers immediately adjoining it, both of which were surrounded by round-cell infiltration. Farther on there was localized degeneration of fibers, apparently due to round-cell infiltration of the perineurium.

The bloodvessels of the radicular nerves showed marked round-cell infiltration of the walls. The degeneration of the roots near the cord was greater than in the radicular nerves.

Summary. Twenty-five radicular nerves from eight cases of tabes dorsalis and four radicular nerves from a case of syphilis were studied. In the eight cases of tabes studied eighteen radicular nerves were cut in serial section from the ganglion to the dura; in the remaining seven radicular nerves the ganglion had unfortunately been removed at autopsy, and only parts of the nerves could be studied. Of the four roots studied from the case of syphilis, in only one was the ganglion present.

The lesion described by Nageotte was present in six cases, although very slight and insignificant in one case. It was absent in two cases. That is to say, there was demonstrated in all of the

six cases round-cell infiltration of the radicular nerves involving one or more of the coverings of the nerve, namely, the peri-, epi-, and endoneurium. This was traced as far as the ganglion in the case of syphilis, and in two cases of tabes (XI and XIV). In these two cases the degeneration of the fibers, by the Weigert method, was also observed.

Hemorrhagic areas of softening were seen in three cases, causing extensive destruction of the posterior roots (XII, XIII, and XV). In two of the cases the symptoms were of long duration, and in one had lasted over three years.

In one case (XIV) two nerves studied showed degeneration by the Weigert method without round-cell infiltration of the peri-, epi-, or endoneurium, except in one root where there was a slight perineuritis. In other roots in the same case round-cell infiltration and areas of softening were observed.

The degeneration of the roots extended toward the ganglion beyond the focus of cellular infiltration in some instances (XII, XIII, and XV). In one case (XV) endoneuritis was observed unassociated with peri- or epineuritis. In one case (XIII) showing extensive cellular infiltration which extended as far as the ganglion there was only slight degeneration by the Weigert method. The symptoms were of four years' duration in this case. Degeneration extended into the ganglion in seven cases (Weigert) (VII, XI, XII, XIII, XIV, XVI, and XVII). In two cases (XVI and XVII) the radicular nerves showed degeneration by the Weigert method, but there was no round-cell infiltration observed either of the peri-, epi-, or endoneurium.

The round-cell infiltration was composed of small round cells closely packed together, and in most instances it was marked in degree. The nerve fibers showed degeneration by the Weigert method in those places where the round-cell infiltration was seen.

In the syphilitic case (XVIII) the appearances were identical with those in the cases of tabes. By the Weigert method, however, the degeneration was slight only, and out of proportion to the round-cell infiltration, which was intense.

The anterior roots were slightly degenerated in three cases

(VII, XIV, and XV), but intact in four cases (XII, XIII, XVI, and XVII).

The cortex was studied in sixteen cases, all showing round-cell infiltration of connective-tissue type. In one case some plasma cells were also present; in another, polynuclear cells; and in a third case mononuclear leukocytes as well.

The meninges of the cord, studied in seventeen cases, showed pure connective-tissue type of cells in nine cases. In three cases mononuclear lymphocytes and connective-tissue cells were observed. In four cases no infiltration was noted, and in one there was only a very slight round-cell infiltration, although the pia was thickened in these cases.

The round-cell infiltration showed no predilection for position, except in two cases where the infiltration was more marked anteriorly and posteriorly, and in the longitudinal fissures.

In eight cases (I, VI, IX, X, XI, XII, XIII, and XV) the infiltration resembled that of syphilis, and was associated with changes in the bloodvessels, consisting of thickened walls and in some cases obliteration of the lumen and endarteritis.

In the eight cases of tabes in which the radicular nerves were studied, four presented the characteristic round-cell infiltration of syphilis, and two others were probably also syphilitic, although the infiltration was not absolutely typical.

Nageotte[1 2 3] was the first to describe neuritis of the radicular nerves in tabes, and he believed that it was the cause of the spinal-cord changes in this disease. He claimed that syphilitic meningomyelitis was present in all cases of tabes, and that this was the immediate cause of the neuritis of the radicular nerves. Peri-, epi- and endoneuritis caused a local atrophy at the site of the inflammatory focus. The cellular infiltration consisted of fixed cells, lymphocytes, and a few epithelial cells. According to Nageotte the neuritis usually implicates the nerve at the middle third of the posterior roots, being situated a little nearer the cord in the anterior roots. The atrophy begins in that part of the nerve which is farthest removed from the ganglion, spreading toward the centre. The regeneration occurs in the anterior roots, but is not seen in the

central stump of the posterior roots, because the endoneuritis spreads downward into the ganglion, and destroys this portion of the fiber. The lesion is a transverse interstitial radicular neuritis of specific origin, which is derived from a chronic specific meningomyelitis.

A late atrophy is observed which affects certain kinds of fibers in each root, and which is irregularly distributed to the different roots of the cord, and different fasciculi of each root. According to Nageotte, the pia of the cord is thickened and infiltrated, the lesion predominating posteriorly. The thickening of the pia is due to hypertrophy of connective-tissue fibers, and the infiltration is largely lymphocytic, with some epithelial, plasma, and polynuclear cells. He claims that the vessels are always altered, particularly the veins.

The radicular nerve* lesion, he stated, is not constant in syphilitic meningitis, which explains why the latter does not always cause tabes. Radicular neuritis is, however, constant in tabes, he claims.

Objections to Nageotte's theory have been raised by Orr[4 5] and Rows, who have observed degeneration of the posterior columns without lesions of the extramedullary course of the posterior roots, and they claim that degeneration of the intramedullary portion of the anterior roots which accompanies so often degeneration of the sensory fibers is the strongest argument against Nageotte's theory, and shows that a neuritic process in the extramedullary portion of the sensory and motor nerve is not essential. Moreover, they claim that the lesion is not a constant one, which is borne out by my observations, and that it is exceeded by the intramedullary lesion, and is different in character. They believe that the sensory fibers have been attacked in their intramedullary course by some toxin and at that point where they enter the cord the noxious agents cause degeneration which spreads centrifugally. Wallerian degeneration, they believe, spreads centrifugally from the point of injury. They quote the work of Erb, Tizzoni, Mönkeberg, Neumann, and Bethe in support of this view. This opinion is contrary to that held by Nageotte, who claimed that this degen-

* The radicular nerve is that part of the root which lies between the point at which it arrives at the dura, and that at which the posterior root reaches the ganglion.

eration began at the distal end of the fiber, and spread backward toward the trophic centre.

That this lesion is not constant has been shown by Oppenheim,[6] who found it absent in two recent cases, and only present in one old case; and by Marinesco,[7] who demonstrated it in only three cases out of five. Nor did Redlich[8] see that there was any parallel between transverse neuritis and degeneration of the posterior cord. He stated that it was lacking in tabes at the beginning, and only apparent with difficulty later.

Thomas[9] and Hauser also declared that the lesion was not constant. While they found lesions comparable to those found by Nageotte, they did not believe that they were of capital importance in the process of degeneration of the roots. In meningomyelitis syphilitica they claim the posterior roots are plunged into intense pachymeningitis without being implicated, and believe that the lesions of the meninges of the roots are episodic. They refuse to admit that the parenchymatous lesions are exclusively dependent on the connective-tissue lesions, not alone because they are inconstant and not in proportion to the atrophy of the roots, but because they do not seem to appertain properly to tabes. Moreover, meningitis is sometimes very intense around the anterior roots without implicating them. They found the nerve fibers implicated in traversing the morbid focus sometimes, and looked upon this as accidental and not the rule. If Nageotte's theory is correct they would expect to find atrophy of the radicular fibers in the interior of the ganglion as a retrograde process. They could not see that this process could produce itself if the radicular fibers were not profoundly degenerated in the primary focus. They have seen an atrophy, slight in the posterior roots, remain slight in the radicular nerve as far as the ganglion.

That this lesion is not characteristic of tabes seems proved by the findings of Massary,[10] who found it present in cases dying of tuberculosis, meningitis, icterus, pulmonary congestion, cerebral hemorrhage, typhoid fever in a child, and pleurisy, and who felt justified in the conclusion that the lesion was without significance.

Cassirer and Strauss[11] cite, in opposition to Nageotte's theory,

cases of incipient tabes associated with syphilitic ulcer between the esophagus and larynx, orchitis syphilitica, rachitis, and thickening of the bones, cases which showed, beyond a slight pial thickening, no meningitis. They believed that this did not support the view that there was always a meningeal origin for the degeneration of the posterior columns.

Marinesco found the fibers in the cord more implicated than in the posterior roots, and in the posterior roots more than the intraganglion fibers, showing, he thought, that the lesion began in the cord and not in the roots. Marinesco and Minea[12] stated that proof of a parallel lesion affection of all the tracts of the central white matter, similar to that of the starting point of the lesion, is of great importance, for it shows first that the lesion of tabes consists of a primary atrophy of the central branch of the sensory system; second, that it is not of interstitial origin, as Obersteiner, Redlich, and Nageotte claim, but of parenchymatous origin. If due to compression of the nerves, or transverse radicular neuritis, it would be impossible to comprehend why this lesion involved at the beginning the intraganglion fibers. These should remain intact, as in compression from section of the nerve, when the peripheral end degenerates in spite of the fact that the central end remains undegenerated.

My own observations are evidence against Nageotte's views. For example, in the case of syphilis the radicular nerve lesion which is described by Nageotte, was present, but there was no tabetic degeneration of the posterior columns. Moreover, in two of the cases there was degeneration of the radicular nerves with round-cell infiltration of the peri-, epi- and endoneurium. Furthermore, the degree of round-cell infiltration was not proportional to the degeneration in the roots as a rule. That is to say, the degeneration is intense when there is slight, as well as intense, round-cell infiltration, or with absence of this lesion.

The disproportion between the round-cell infiltration and the degeneration in the radicular nerves is not an argument against his theory, Nageotte believes, for he asks: What parenchymatous lesion *is* always proportional to the interstitial lesion? He believes

that individual resistance comes into play, and calls attention to the fact that the syphilitic infection is not always uniform, and the lesions are variable. But the fact that neuritis of the radicular nerves is seen in other conditions as described by Massary, and as observed in my case of syphilis of the nervous system, is, in my opinion, one of the strongest arguments against Nageotte's theory.

Meningitis.—The presence of meningitis in tabes dorsalis has been frequently described. Whether or not it is constantly present is still open to discussion. It was present in thirteen of the seventeen cases in my series. In four of the seventeen cases it was not demonstrated, in any of the sections studied, in the meninges of the cord, although the pia was thickened, but in the meninges of the paracentral region in these four cases there was some infiltration. The round-cell infiltration did not differ greatly from the round-cell infiltration of syphilis. The process was evidently a chronic one, the cells being of a connective-tissue type in most instances. In three cases the connective-tissue cells were associated with mononuclear leukocytes. The typical specific appearance of the meninges was demonstrated in eight cases, including the characteristic bloodvessel change of this disease. There was no predilection as to the situation of this round-cell infiltration, which predilection, according to Marie and Guillaine,[13] is for the posterior meninges. They also state that the lesion is less pronounced or absent in the sacral region. This was not confirmed in my cases, as the meningitis was present in the sacral region in some cases. Lepine[14] claimed that the primary sclerosis localized the meningitis, while Vulpian,[15] on the contrary, believed that there was no uniformity in the meningeal lesion.

In my cases the impression given was that the meningitis was not sufficiently intense to be considered an important factor in the causation of the lesion that was found in the roots or the posterior columns. It was not constantly present, being practically absent in four cases. This observation coincides with that of Redlich, who did not believe the meningitis was a constant finding in tabes. He claimed that there are some cases in which it was not present, although there was thickening of the pia, and he was of

the opinion that the primary posterior sclerosis localized the meningitis. Leyden[16] regarded it also as secondary.

On the other hand, Lang[17] believed that meningitis was a constant finding, and according to Arndt[18] the meningitis was the starting point of the tabetic disease, while Türck[19] long ago called attention to the meningeal change in disease of the posterior columns.

The evidence in my cases points to the conclusion of some authorities that the meningitis as well as the radicular changes are a part-symptom, rather than the cause, of the tabetic degeneration. Typical cases of tabes clinically have been cited supporting this view, in which there has been associated pathologically syphilis of the nervous system and other organs. Examples of these are Schittenhelm's case[20] of incipient tabes in cerebrospinal syphilis; Sach's case[21] of undoubted tabes with specific round-cell infiltration of the pia, and bloodvessel change; Nonne's three cases[22] complicated by gumma of the cerebrum and one of incipient tabes and specific spinal meningitis; Cassirer and Strauss' cases[11] of incipient tabes with syphilis of the other organs; Fraenkel's case[23] of tabes and specific arachnitis and leptomeningitis obliterans; Hoffman's case[24] of specific meningitis and diseased bloodvessels; Pick's case[25] of classical tabes and chronic specific meningitis; Sydney's case[26] of vascular change of the spinal cord, and similar cases of Adrian,[27] Miner,[28] and Dinkler.[29]

The cases of pseudotabes in which there is a syphilitic meningomyelitis without tabetic change in the posterior columns, seems to me to be evidence in opposition to Nageotte's views. I refer to the cases described by Giuffre and Mirto,[30] Lamy,[31] Maplain,[32] Eisenlohr,[33] Ewald,[34] Oppenheim,[35] Wolff[36] and others, in which there were present atypical symptoms of tabes clinically, and lesions characteristic of cerebrospinal syphilis pathologically.

If meningitis is not constantly found in all stages of the tabetic process, it is certainly a *frequent* finding, and probably present at some time in the progress of the disease. In the four cases in my series in which round-cell infiltration was not observed, the pia was thickened. However, border or *Rand* degeneration was found in eight of my cases (I, III, V, X, XI, XII, XIII, and XVI). In one

of the cases in which there was no meningitis demonstrable, the *Rand* degeneration was found, and probably also in a second case, indicating that probably at some stage of the pathological process meningitis had been present. *Rand* degeneration has been already described by Pick, Edens,[37] and Minor in cases of tabes complicated by specific meningitis. The question whether the meningitis corresponds to the intensity of the process in the spinal cord has been answered in the negative by my cases. There was no evidence that the meningeal lesion was more intense posteriorly than elsewhere.

Is the meningitis present in old as well as in recent cases, and does the infiltration differ in character in the old and recent cases? This question must be answered by future observations.

In two advanced cases in my series the round-cell infiltration of the meninges was very intense, but in other cases where the tabetic degeneration was intense and advanced, the meningitis was less marked, and out of proportion to the systemic disease.

It has already been shown that the pathological appearance of tabes when the other organs are syphilitic, does not differ from those when the organs are not syphilitic (Cassirer and Strauss). This was true in one case of mine in which there was syphilitic myelitis plus tabes (XIII). It is also clear that the pseudotabes, due to syphilitic myelitis, has a different anatomical basis.

There is no doubt that syphilis, either of the organs, skin, bones, or central nervous system and tabes may occur as independent processes at the same time and in the same individual.

Conclusions.—1. The radicular nerve lesion is not constant in tabes dorsalis.

2. Meningitis is not constant in all stages of tabes dorsalis.

3. Lesions of the posterior columns in cases of tabes dorsalis complicated by syphilis do not differ from those found in cases in which there is no evidence of syphilitic lesion.

4. Syphilitic meningitis implicating the radicular nerves in cerebrospinal syphilis may exist without causing the characteristic tabetic spinal-cord lesion.

5. The meningitis in some cases of tabes is typically specific in its appearance, but differs in degree in some and is not present in all cases.

6. The cerebral meninges were infiltrated with round cells in all the cases studied.

7. *Rand* or border degeneration is present in a certain proportion of the cases. This is an observation that has already been made, but not emphasized, in the literature.

LITERATURE

1. Nageotte. La Presse Médicale, December 10, 1902, 1179.
2. Nageotte. La Presse Médicale, January 5, 1903.
3. Nageotte and Riche. Manuel d'Hist. pathol., 1907, 316.
4. Orr and Rows. Premier Congress Internat. de Psych. de Neurol., etc., Amsterdam, September, 1907, 23.
5. Orr and Rows. Brain, 1904, No. 27, 460.
6. Oppenheim. In Paviot: Lyon Méd., 1905, 913.
7. Marinesco. La Semaine Méd., 1906, No. 26, 181.
8. Redlich. Ibid. in Marinesco.
9. Thomas and Hauser. Nouvelle Icon. de la Salpêtrière, 1902, 290.
10. Massary. In Paviot.
11. Cassirer and Strauss. Monatsschrift f. Psych. u. Neurol., 1901, No. 10, 241.
12. Marinesco and Minea. Jour. de Psych. et Neurol., 1907-8, x, 182.
13. Marie and Guillaine. Revue Neurologique, 1903, xi, 49.
14. Lepine. Lyons Méd., 1905, cv, 81.
15. Vulpian. In Paviot.
16. Leyden. In Paviot.
17. Lang. In Redlich.
18. Arndt. In Redlich.
19. Türck. In Redlich.
20. Schittenhelm. Münch. med. Woch., 1903, 1956.
21. Sachs. New York Medical Journal, 1894, 1.
22. Nonne. Syphilis und Nervensystem, 1909, 461.
23. Fraenkel. Berl. klin. Woch., 1893, 1224.
24. Hoffmann. Neurologisches Centralb., 1897, 51.
25. F. Pick. Arch. f. Dermatol. u. Syphilis, 1898, xliv, 91.
26. Sydney. Centralbl. f. allgemeine Path. u. Path. Anat., 1892, 30.
27. Adrian. Zeitsch. f. klin. Med., 1904, 327.
28. Minor. In Boettiger: Arch. f. Psych., 1894, vi, 649.
29. Dinkler. Deutsch. Zeitschr. f. Nervenheilk., 1893, iii-iv, 19.
30. Giuffre and Mirto. In Panegrossi: Monatssch. f. Psych., 1908, 290.
31. Lamy. Ibid.
32. Maplain. Ibid.
33. Eisenlohr. Festschrift des neuen Krankenhauses, Hamburg-Eppendorf, 1889, 298.
34. Ewald. Berl. klin. Woch., 1893, 284.
35. Oppenheim. Berl. klin. Woch., 1888, 1061.
36. Wolff. Arch. f. Psych., 1891-2, xii, 44.
37. Edens. In Valentini: Neurol. Centralbl., 1899, 46.

DISCUSSION

Dr. William G. Spiller: Tabes is such a very common disease it is not surprising that for many years attempts have been made to determine exactly where the degeneration commences. Very few neurologists at the present day believe that multiple neuritis is the essential cause of tabes, though very few doubt that multiple neuritis is common in tabes. The theory that the disease commences in the ganglia of the posterior roots is accepted by some, but investigations have not given conclusive evidence of this. Two other views have been widely accepted, one advanced by Nageotte and the other by Obersteiner and Redlich. I happened to be in Vienna shortly after the views of the latter were announced. There is no doubt that the posterior roots on entering the cord become contracted and lose their medullary sheaths, and therefore are susceptible to any toxic substance circulating in the spinal fluid, such as that of syphilis. It has not been proved, however, that tabes commences at the entrance of the posterior roots into the cord.

About the same time Nageotte advanced the views which Dr. Rhein has referred to tonight. It was my fortune to be in Paris about that time, and I had the opportunity of seeing Nageotte's specimens. The condition of the radicular nerve in pronounced tabes would suggest that the lesion may commence at this portion, but, as Dr. Rhein has shown, there are cases of tabes in which the radicular nerve is not so involved. Vincent has studied the cranial nerves to determine whether the same changes occur in them as in the posterior roots, and has found similar conditions.

We have no satisfactory explanation of the occurrence of optic atrophy in tabes. The alteration of the cells of the retina might be secondary as well as primary, as it is not unlike the changes in the spinal ganglia. There has been no demonstration that there is a condition of strangulation of the optic nerve by thickening of the dura in cases of tabes, and as yet we are ignorant as to why atrophy of the optic nerve occurs so early and so frequently in tabes.

DESCRIPTION OF PLATES

Fig. 1.—Shows intense degeneration of the posterior root of the radicular nerve and very slight degeneration of the anterior root (Weigert stain).

Fig. 2.—Shows degeneration of the sensory root extending as far as the ganglion. The anterior root is intact.

Fig. 3.—Shows hemorrhagic softening of the posterior root of the radicular nerve and intact anterior roots.

Fig. 4.—Round-cell infiltration of sensory root of a radicular nerve from a case of syphilitic meningomyelitis (hemalum and acid fuchsin).

FIG. 1

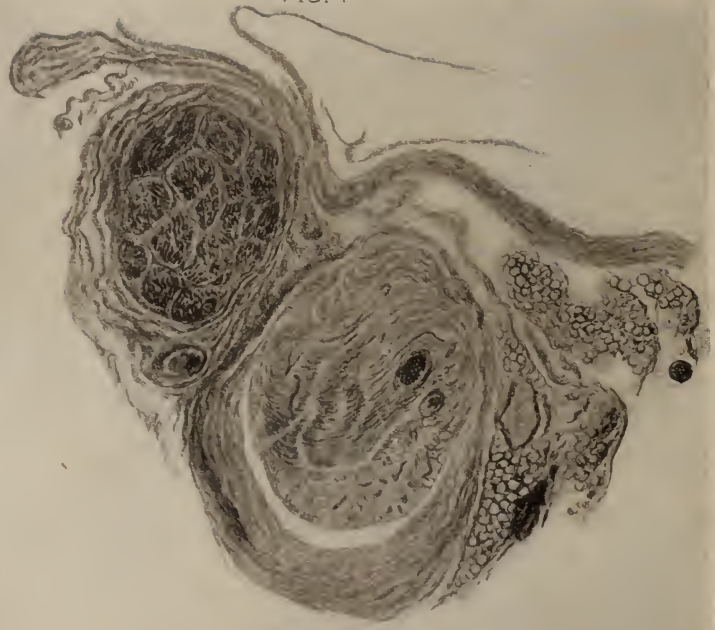


FIG. 2

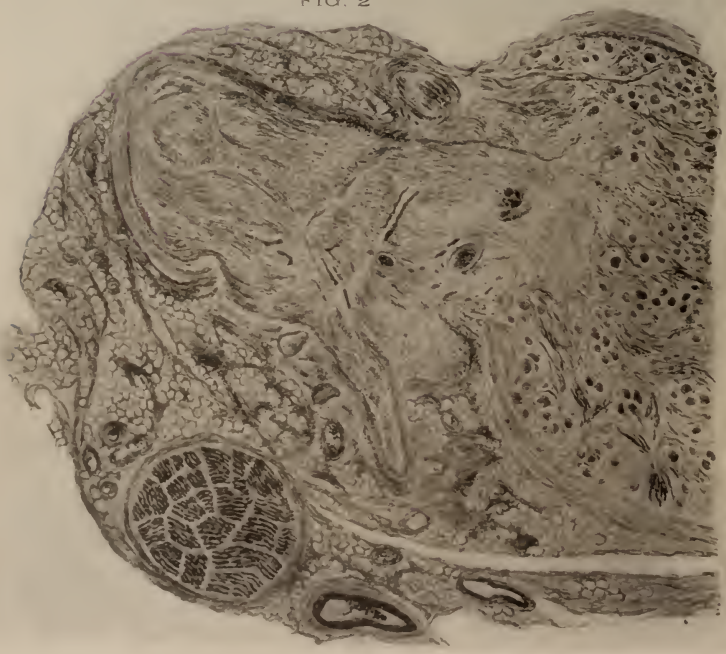


FIG. 3

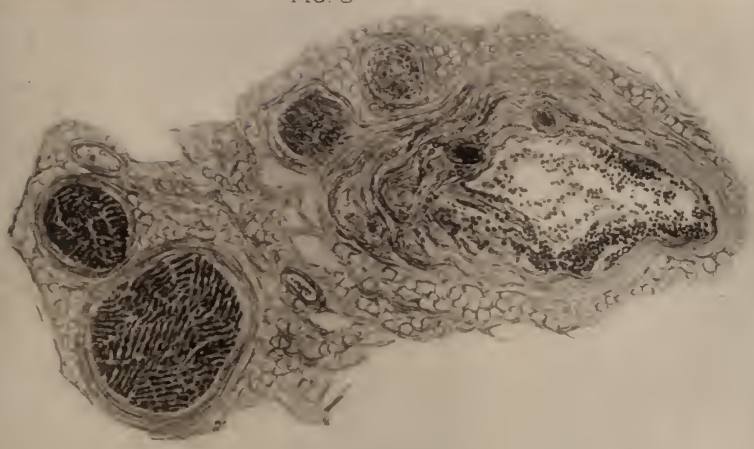
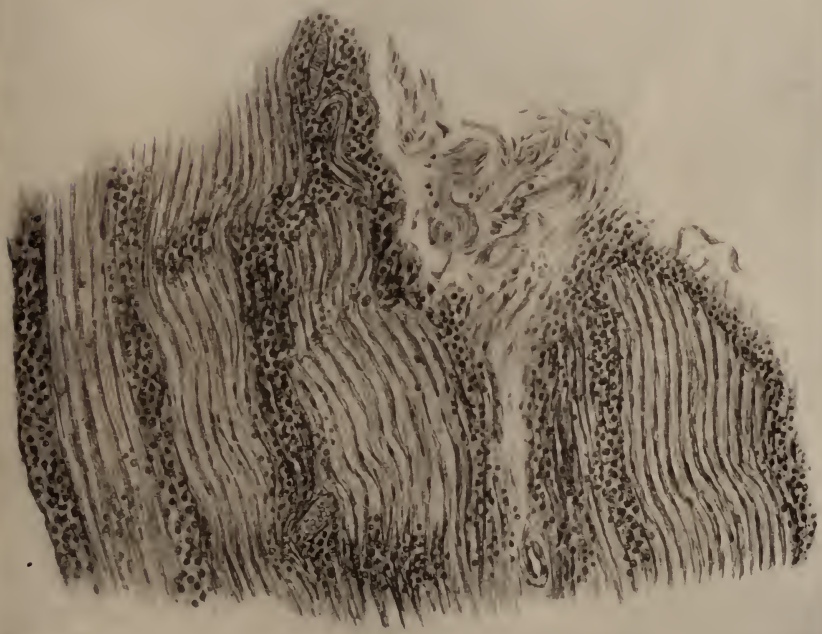


FIG. 4



Dr. George E. de Schweinitz: Replying to Dr. Spiller in regard to the origin of the atrophy of the optic nerve in tabes dorsalis, I would say that a number of observers believe that the primary seat of the disease is in the retina. Thus, Ward Holden maintains that tabetic atrophy of the optic nerve depends upon a disease and disappearance of the retinal ganglion cells, and the atrophy is most noticeable near the globe, diminishing toward the brain. In other words, degeneration of the nerve fibers is regarded as secondary to disease in these ganglion cells. In this respect the atrophy resembles that which takes place under the influence of certain toxins, for example, methyl alcohol, quinine, etc., in which, in all probability, the earliest change takes place in these ganglion cells, and the atrophy of the optic nerve fibers themselves is secondary to these changes.

PELLAGRA, WITH A REPORT OF TWO CASES WITH NECROPSY[1]

By PAUL V. ANDERSON, M.D.
OF MORGANTON, N. C.
AND
WILLIAM G. SPILLER, M.D.
OF PHILADELPHIA, PA.

Clinical Report by Dr. Anderson. Case I.—Mrs. D. E., white, aged twenty-two years. The family history is negative except for the fact that one brother died with pulmonary tuberculosis. The patient had the diseases common to childhood. Catamenia occurred at sixteen, and was regular, but has been absent since March, 1909. She has always been in good health until four years ago, when she began to have gastric disturbance. This began in the spring, but became less severe during the fall. The following year, in March, her gastric symptoms returned and she had a persistent diarrhœa, with several watery stools a day. Later, the dorsal aspect of her hands and wrists became reddened and the palms roughened. There was a reddened patch on the neck, at the root of the hair, and on the nose and at the corners of the mouth. The patient states concerning her hands: "They were red, itched, and were sore, and looked just like they had been dipped in hot water and scalded." The elbows were also red and roughened. The mouth and tongue were sore. Salivation was profuse. Hunger and thirst were excessive, and there was considerable loss of weight. She was able to do her housework, however, and was not confined to bed. After a short time the skin of the hands and of the patches on the nose and neck peeled off. The diarrhœa

[1] Read December 7, 1910.

gradually grew better, and in the fall the patient gained flesh and seemed to be in fairly good health. In March of the following year the eruption again appeared as before, accompanied by the symptoms previously enumerated, but they were more severe, especially the diarrhœa, and the patient became so ill that she was confined to her bed. In August, 1909, she was taken to a general hospital, where she remained for a month. When she left the hospital she was better; the skin of her hands had again peeled, but the hands were roughened. She was unable to take up her housework, however, on account of weakness and nervousness. She also was not able to walk well, and at times felt dizzy and blind.

The patient became disturbed mentally in January, 1910, and was admitted to the Western North Carolina Hospital for the Insane February 27, 1910. The duration of the mental trouble before admission was one month. Prior to admission she was sleepless, restless, apprehensive of bodily harm when left alone, silly in speech and behavior, and had hallucinations of sight. At one time she threatened suicide. The physician who committed the patient made a diagnosis of "neurasthenia bordering on melancholia." (This diagnosis has frequently been made in cases which later proved to be pellagra.)

Since the patient has been in the hospital she has been emotionally unstable, weeping without the slightest cause, and occasionally smiling in a wan way. As a rule, however, she has an anxious, apprehensive expression on her face. She says that her blood and nerves are wrong; that her uterus and stomach are terribly diseased. She complains of excessive pains in her ankles and knees. She says, also, that her back is weak and causes her pain. There is marked salivation—in fact, so great is this that her pillow is frequently wet by it. Her appetite is ravenous and her thirst is excessive. Her mouth and tongue are sore and she complains of a burning sensation in the œsophagus and stomach. She is constantly complaining of these symptoms and begs the doctor to give her medicine for them, as long as he is in sight. She also begs him pitifully not to let her die. In answering questions she is more or less confused, at times, and her memory is defective. She speaks

in a monotonous voice, never varying the tone. She walks with difficulty, but for a few days after admission she was able to walk from her ward to the porch without assistance.

Physical Examination, March 19, 1910: The patient (Fig. 1) is well developed, but very much emaciated. She has an anxious, agitated expression on her face, and cries and moans almost con-

Fig. 1.—Photograph of the patient (Case I), showing the retraction of the head.

stantly, bewailing her fate. At times she has a mask-like expression of the face. There are no asymmetries of face. The ears are well formed; lobules attached. The pupils are regular; contracted; react sluggishly to light and to accommodation. There is no nystagmus and no strabismus. The conjunctivæ are sensitive to touch. The tongue is protruded straight, but marked coarse tremors are present. The edges of the tongue are reddened and the central part is covered

with a brownish coating. Salivation is present to a marked degree. There is a reddish-brown discoloration extending from the base of the neck upward to the hair-line, and there is also a reddish purplish discoloration on the dorsal aspect of the hands, extending an inch or two above the wrist (Figs. 2 and 3). This is symmetrical on each side. Nothing abnormal is noticed about the palms. The normal lines of the skin on the dorsal aspect of the hands seem to be lacking. The chest is symmetrical, more or less flattened, and the subclavicular fossæ show a more or less marked depression on each

Fig. 2.—Photograph of the hands, showing the pellagrous eczema on the dorsal surfaces.

Fig. 3.—Photograph of the right hand alone, showing the eczema more distinctly.

side. No abnormality can be determined by percussion, but auscultation reveals harsh breath sounds at the left apex. The heart is apparently normal in size and no murmurs can be heard. The abdomen is slightly distended. No masses can be felt. The abdominal organs are apparently normal. The liver is contracted. It extends from the fourth interspace to the seventh rib in the mid-axillary line. The abdominal reflexes are absent. The plantar reflexes are greatly exaggerated. The Babinski reflex and ankle clonus are not obtained. The patellar reflex is greatly exaggerated. The

patient complains of excessive pain when she is tested for ankle clonus. There is a marked, coarse tremor of the head, and movements of the hands and arms are more or less athetoid or ataxic. There is marked incoördination in the upper extremities, the patient being unable to place her hand on her nose with the eyes shut. The station is poor; the patient shows a tendency to sway, and would doubtless fall if she were not caught when the eyes are closed. The gait is more or less spastic and uncertain. She cannot walk without assistance, and walks with the feet spread wide apart. Apparently she has difficulty in recognizing the difference in the heat and cold tests on the feet and legs, but she could tell the difference when the tests were applied to her abdomen. The test for touch and pain could not be carried out on account of the patient's failure to cooperate. There are many coarse tremors of the hands when they are extended.

Smell: Turpentine; castor oil; ammonia, not recognized; camphor, correct.

Taste: Sour, correct; salt, correct; bitter, sour; sweet, not recognized.

March 30, 1910. Numerous bullæ have developed on the dorsal aspect of patient's hands, and in places these have broken, leaving sores. There is a marked reddening all over the dorsal aspect of the hands. There is also marked scaliness with excessive redness of the forehead, on the nose, and on the back of the neck. The elbows are very much roughened. The patient is quite emotionally unstable. She is fearful that she will die, and cries a great deal of the time. She almost invariably has an anxious, set expression on her face, and although, at times, she laughs in a silly way, her expression is more or less fixed all the time. There is marked redness of the mucous membrane of the mouth; the tongue is reddened and fissured, and there is an ulcer at each corner of the mouth. There is also marked salivation. She walks with difficulty—in fact, she cannot walk alone at all. The patellar reflex is greatly exaggerated. She eats ravenously and is excessively thirsty. She also, at times, has slight opisthotonos, and complains of excessive pains in her legs. She also states that her hands burn terribly. Her bowels are constipated. She sleeps scarcely at all.

April 15, 1910. The patient is growing much weaker. She has a persistent diarrhœa, with several watery, foul-smelling stools a day. She is excessively nervous and her muscles twitch a great deal. This condition exists even in her sleep. She is greatly depressed and is apprehensive that something terrible is going to happen to her. She cries a great deal and begs constantly for food and water. The deep reflexes are still greatly exaggerated. The opisthotonos is increasing in severity. She cannot walk at all and has to be carried to her chair on the porch.

May 1, 1910. The patient is confined to bed. There are marked clonic convulsive movements of her legs and arms, and twitchings of her whole body; in fact, she is scarcely still a minute. The slightest touch produces a marked convulsive movement. She is still excessively thirsty and eats ravenously. She has a persistent diarrhœa, with numerous watery, foul-smelling stools each day. The dorsal aspect of her hands presents a reddish, purplish appearance. The epidermis is coming away in scales. There is also a scaliness about the corners of the mouth, on her nose and forehead, on the back of her neck, and on her elbows.

May 8, 1910. The patient is much weaker. Speech is thick and she expresses herself with difficulty. At times she is delirious. There is a very marked opisthotonos and there are clonic convulsive movements of the arms and legs. At times there are tonic spasms, and marked muscular twitchings are present most of the time. The mouth is excessively reddened, with saliva drooling from it, and the tongue is beefy in appearance. The deep reflexes are still greatly exaggerated, but are not so much exaggerated as they were for a time.

May 9, 1910. The patient died today.

March 1, 1910. Urinalysis: Straw-colored, flocculent precipitate; slightly acid; 1010; trace of albumin; no sugar; no casts; many urates; a few epithelial cells.

March 3, 1910. Examination of sputum for tubercle bacilli, positive.

April 23, 1910. Urinalysis: Light amber; clear; acid; 1013; no albumin; no sugar; no casts; many epithelial cells.

April 23, 1910. Feces examined—no hookworm ova found.

Case II.—E. A. H. (under the care of Dr. Jas. K. Hall. Notes by Dr. Hall).

This man was admitted to the Western North Carolina Insane Asylum in 1888, at the age of forty, from a county in the extreme western portion of the State. He had been married for ten years and had a wife and two children. He was a gunsmith and cabinet-maker, but he had no education and was without property. For ten years or more before admission he had been wandering about over the neighborhood, had done little work, and for perhaps more than ten years he had been looked upon as mentally abnormal. At times he was mute for days; sometimes he was extremely irritable, had visual hallucinations, and he occasionally threatened violence to members of his family and his neighbors. He attempted suicide, and pending admission to the hospital he was kept in the county jail for several weeks.

When admitted to the hospital the patient was a quiet dement, in rather frail physical health. Two years after admission he had a severe attack of influenza, but he made a good recovery, and six years later he had measles. When able, he worked on the farm, but there was a loud, systolic murmur, and at times his feet became so swollen that confinement to bed was necessary for a short time. In the latter part of 1903 he was transferred from the main building of the hospital to the colony, where the patients all engage in outdoor work, and this man found employment in breaking stones with a hammer, for macadamizing the roads. The note was made that his physical health during the winter of 1903-04 was first-rate, but a line in his history, dated April 1, 1904, states that he has an eczema-like eruption on his hands, and for that reason he is left indoors. On June 16, 1904, it was noted that he had been in bed for several days because of disturbances of cardiac compensation; that he had been unusually depressed and ate little, but the condition of the hands had improved. In the early part of October he was said to be very weak, emaciated, and there were bedsores. His physical condition had improved by the spring of 1905, and he was again able to be out of bed. For the following two years he

remained in the hospital building, doing a little work in the ward, and it is presumed that his physical health was fairly good, inasmuch as no mention is made of illness in the history. On May 15, 1907, the following note was made: "This patient was transferred from the hospital building to the colony about April 1; he busies himself in helping to keep one of the buildings in order, but he is profoundly demented, and the scope of his intellectual activity is extremely circumscribed. It is impossible to induce him to raise his voice and he speaks always in a whisper. His general health is not robust, but apparently fairly good." The old man remained at this colony until September 24, 1909, when he was again placed in a hospital ward because of failing physical health. At that time the backs of the hands looked as if they had been badly sunburned. The bowels were loose, the appetite was failing, and he was losing in weight. The gait was uncertain and tottering; the movements of the upper extremities were athetoid; the protruded tongue was tremulous, and the deep reflexes were exaggerated. Ankle clonus and Babinski's sign were absent. No doubt was felt that the condition was due to pellagra.

The decline was steady and progressive. The diet was restricted principally to milk, and although sufficient nourishment was taken, emaciation increased. Dementia was so far advanced that no intelligent statements could be elicited from the patient. Diarrhœa was troublesome, and all control of the movements was soon lost. Tonics were given and efforts were made to control the diarrhœa, but without avail. As the emaciation increased, bedsores developed. The bed was soiled every few minutes. The bowel movements were a dark, grayish liquid, and peculiarly offensive. The lower extremities became drawn, and efforts to extend them seemed to cause great pain. There were almost constant, apparently purposeless, movements of the upper extremities, extremely awkward and incoördinate. He was extremely restless and his behavior induced the belief that he was annoyed by visual hallucinations. As the disease progressed, the muscular disturbance became more marked. In addition to the gross movements of the upper extremities, there were spasmodic movements of the fingers.

The eyelids frequently moved rapidly. At times there were clonic, convulsive-like movements of the whole body, of momentary duration. Not infrequently an unusually loud inspiratory grunt could be heard, due probably to spasmodic contraction of the diaphragm and other inspiratory muscles. Firm pressure on the skin seemed not to produce pain, but the gentlest tap on any part of the surface caused generalized, clonic muscular spasm. Pupillary abnormality was not noted. The temperature was never much above normal and in the last days it was slightly subnormal. The pulse became quite small and rapid. Urinalysis showed a trace of albumin and a few hyaline casts. Repeated differential blood counts invariably showed an increase in the number of large lymphocytes. One count gave the following result: Polymorphonuclear neutrophiles, 52.75 per cent.; eosinophiles, 2.5 per cent.; large lymphocytes, 22.75 per cent.; small lymphocytes, 22 per cent.

Death occurred January 3, 1910.

The necropsy showed nothing unusual. Emaciation was extreme; the muscles were quite red; the lungs and pleuræ were normal; the heart was somewhat enlarged, and the mitral leaflets were gnarled. The spleen was small, dark, and tough; the liver was about normal in size and consistence, and the intestinal wall was thin and pale. The kidneys were small; the capsule was adherent; the organs were tough and the cortex shrunken.

Remarks. It will be observed that this man was an inmate of the institution for twenty-two years before his death. During this time he had lived a sheltered, protected life, in a climate noted for its healthfulness. He was probably the first patient in the hospital to develop pellagra. It is scarcely to be doubted that the soreness of the backs of his hands noted in 1904 was the dermatitis of pellagra. For the following five years there were apparently no symptoms of the disease. The final attack developed late in the summer. For more than two years before his last illness he lived in a colony with seventy-five other patients, almost a mile from the hospital, and during this time he was not near any pellagrous patients. His diet and his hygienic conditions were exactly those of a thousand other patients. Contagion was not possible. If the food and

surrounding conditions caused the disease it seems strange that he alone should have been affected.

THE PATHOLOGY OF PELLAGRA BY DR. SPILLER. The number of clinical cases of pellagra reported in this country has become quite large since the disease was first recognized here a few years ago. So far as I know, no report of a necropsy in any of these cases has been published, and it is important to determine whether the pathology of the American cases conforms to that of the European or not. It is presumable, however, as the symptoms of the disease are essentially the same in our country and in foreign lands, that the pathology will not vary greatly. Pathological reports are found chiefly in the Italian language, and the only one in English known to me is by Batten, who studied the spinal cord in three cases described by Sandwich.[1] Batten found degeneration of the posterior columns in two cases, but the third case showed practically no change. He believed the sclerosis of the posterior columns to be of root origin. The process was a chronic one, as shown by the fact that the posterior columns were extensively sclerosed and no degeneration was revealed by the Marchi stain. This report by Batten is especially interesting in that it seems to show that the degeneration in the spinal cord was not rapidly progressive, otherwise changes would have been detected by the Marchi stain.

Tanzi,[2] in the recent English translation of his text-book, says that Tonnini, in 1883–1884, was the first to associate the spinal phenomena of pellagra with primary spinal lesions (cellular pigmentation) of the anterior and posterior horns of the spinal cord. In cases of long standing there may be general or local œdema of the brain, hyperemia, and thickening of the meninges, chronic internal hydrocephalus, and sometimes softening of the cerebral substance and hemorrhages. Accumulations of pigment are also to be observed in the cells of the spinal cord and in those of the sympathetic ganglia. The spinal cord at an early stage exhibits traces of systemic degeneration of combined type, that is, lesions of the posterior

[1] Jour. of Path. and Bact., 1901, vii, 460.

[2] A Text-book of Mental Diseases, translated by W. Ford Robertson and T. C. Mackenzie, Rebman Co., New York.

columns and of the crossed pyramidal tracts, as has been shown by Tuczek and Belmondo. There is also very often small-cell infiltration of the spinal meninges. In the acute cases the nerve cells of the cerebral cortex are swollen; in some instances the nucleus is displaced to the periphery, the processes are atrophic, and there is central chromatolysis.

Babés[1] and Sion, in their monograph on pellagra, state that in most cases of this disease nothing peculiar was found in the spinal roots, but in other cases notable degenerative changes were found in the posterior roots. In the spinal cord were pronounced pigmentation of the nerve cells of the anterior and posterior horns, and often combined sclerosis.

Babés and Sion, in their own cases, found the posterior roots often degenerated, and the degeneration of the posterior columns was secondary to this, but differed from that of tabes in the less involvement of Lissauer's zone and of the anterior root zone, unless the pellagrous changes in the posterior columns were far advanced, when these zones also were degenerated. The cells of Clarke's column were always affected. The cells of the anterior horns were degenerated, as were also the cells of the cerebral cortex. They regard the changes as produced by some poison.

Lukács and Fabinyi,[2] in a recent paper, state that system degeneration of the spinal cord is rare in pellagra. The cerebral meninges in their cases were intact, but in one case the spinal pia was a little thickened in places and infiltrated with cells. They found no unusual arteriosclerosis, although Marianis records arteriosclerosis as constant in pellagra. The medullated fibers of the brain, cerebellum, and medulla oblongata were normal (Marchi's method, however, was not used). In two cases the spinal tracts were intact, in a third the columns of Goll were degenerated from the pyramidal decussation to the upper thoracic cord. Many cells of the posterior horns were degenerated from the cervical swelling downward, but less intensely in lower levels, and this cellular degeneration is supposed by the writers to have been the cause of the degeneration of

[1] Nothnagel's System,

[2] Allg Zeitsch. f. Psych., 1908, lxv, 657.

the columns of Goll. Degeneration of these columns, they state, is very common in pellagra, and differs from that of tabes in that it is seen only in the cervical region, and in that Lissauer's zone is intact. The cells of Clarke's column were greatly degenerated. Nuclei of sensory nerves in the medulla oblongata and pons were scarcely altered, while motor nuclei here were intensely affected. The cells of the anterior horns were greatly degenerated, especially in the cervical region, and showed granular chromophilic elements at the periphery, and a homogeneous centre, with absence of nucleus. The cells of the brain cortex were likewise affected, and especially those in the central convolutions. The lesions, they state, correspond to those of ergotin, mercury, or aconite poisoning, and pellagra is a disease of toxic nature.

Parhon and Papinian[1] seem to be the only investigators who have studied the neurofibrils in pellagra. They found the alterations less intense in the small cortical cells of the brain, and most intense in the Betz cells. The neurofibrils stained less deeply, were thinner, even fragmented. In some small pyramid cells they were not altered. In the large cells the neurofibrils were almost completely absent; in some they were preserved at the periphery and in the cell processes. Alterations were more intense in the cervical region than in the lumbosacral region, and were of the same kind as in the Betz cells.

Pathological Report of Case I (Case of Dr. Anderson). The nerve cells of the anterior horns of the lumbar region are intensely degenerated. The cell body is swollen, the nucleus is displaced to the periphery, the dendritic processes of many cells have disappeared, and the cell body shows intense chromatolysis, sometimes implicating the whole cell, sometimes leaving a zone of chromophilic elements at the periphery of the cell body. The cells of the anterior horns stained by the Bielschowsky silver stain show an absence or a fragmentation of the neurofibrils. There is no round-cell infiltration of the pia. The anterior and posterior roots appear to be normal. Marchi's stain reveals diffuse degeneration in the posterior and anterolateral columns, but less in the posterior columns

[1] Comptes-rend. de la Soc. de biologie, 1905, lviii, 360.

near the gray matter. Numerous holes, from which nerve fibers have disappeared, are found in the anterolateral columns. The pia is not thickened and the bloodvessels are not sclerotic. The thoracic cord is much distorted, probably as a result of injury at the necropsy. Here and there a swollen axis cylinder may be found in the anterolateral columns. The cells of the anterior horns present the same condition as do those in the lumbar region. The

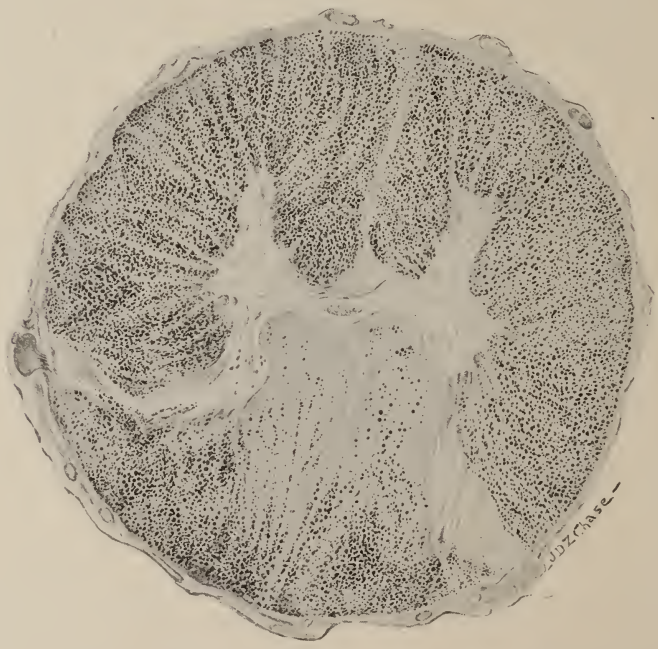


Fig. 4.—Drawing of a section of the thoracic cord from Case I, showing the diffuse degeneration of the posterior and lateral columns by the Marchi stain.

cells of the columns of Clarke show similar changes. The degeneration of the posterior and anterolateral columns by the Marchi stain is pronounced (Fig. 4). Only the lowest part of the cervical cord was obtained. The anterior horn cells are in the same condition as are those in the lumbar region. The anterior and posterior roots of the eighth cervical and first thoracic segments, cut separately from the cord, appear to be normal. The capsules of the cells of the

lumbar posterior ganglia show much proliferation of their lining cells, and the nerve cells are in part degenerated. Cells of the hypoglossus nucleus present a condition similar to that of the cells in the anterior horns, but of less intensity. The cells of Betz and the nerve cells of the deeper cortical layers in the paracentral lobules show changes similar to those of the anterior horn cells, that is, swelling, chromatolysis, and displacement of the nucleus (Fig. 5).

FIG. 5.—Drawing of nerve cells from the paracentral lobule and the anterior horns of the lumbar region. Cell of Betz from the paracentral lobule. One of the larger pyramidal cells of the deeper layers of the paracentral lobule. Cells of the anterior horn of the lumbar region. All these cells are much degenerated.

Pathological Report of Case II (Case of Dr. Hall). Only a small piece of the spinal cord was obtained, and this was from the thoracic region. The pia is distinctly thickened. Diffuse but slight proliferation is found in the lateral and posterior columns; the cells of the columns of Clarke are much swollen; the nucleus is eccentric, and the dendritic processes of some of the cells have been lost. The cells of the anterior horns are in a similar condition, but in some of these the chromophilic elements have disappeared from the periphery of the cell and are found nearer the nucleus; in others they persist only at the periphery. Spaces are found in the antero-

lateral columns from which nerve fibers have disappeared. The vessels of the cord are somewhat sclerotic. The Marchi stain shows intense recent degeneration in the peripheral parts of the posterior columns, in the crossed pyramidal tracts and anterolateral columns, but less degeneration directly in front of the crossed pyramidal tracts and in the median and ventral portions of the posterior columns. The connective tissue of the sciatic nerve and the intima of the vessels in the nerve are proliferated. The nerve fibers of this nerve are normal.

It is evident from the brief abstracts of the foreign representative papers treating of the pathology of pellagra that there is a difference of opinion as regards the systemic or non-systemic appearance of the degeneration in the spinal cord. This is a matter of some importance, as a toxic degeneration is more likely to be non-systemic. In the two cases I have studied the degeneration was diffuse. Indeed, from my own experience I have come to believe that, with the exception of Friedreich's ataxia, there are few disorders causing a truly combined systemic disease of the spinal cord. The degeneration observed in anemia is not systemic, but in the cases I have studied (quite a large number) it has invariably been a diffuse process. It is more intense than that I have observed in pellagra, but not of an essentially different character. The nerve cells, however, are much more affected in pellagra than in anemia.

Writers seem to agree as to the pronounced degenerative changes in the cells of the anterior horns of the spinal cord and of the cortex of the cerebral hemispheres in pellagra. It appears from the first case reported in our paper that the moderate degeneration of the pyramidal tracts predominated clinically over the apparently more intense alteration of the cells of the anterior horns, so that exaggeration of patellar reflexes was present.

The view has been expressed (Long) that the thickening of bone about the intervertebral foramina, possibly more in the cervical region, may be a cause of the symptoms. Unfortunately, only the extreme lower part of the cord in the cervical region in Case I was obtained, but posterior and anterior roots from this region, cut separately, showed no distinct degeneration, even by the Marchi stain. Had

these roots been implicated in the intervertebral thickening, degeneration would have been detected in them. I have found no indication of root degeneration in the thoracic or lumbosacral region, and the alteration of the posterior columns, at least below the eighth cervical segment, is clearly endogenous, as it is also in the piece of thoracic cord obtained in the second case.

I must conclude, so far as a study of these two cases permits, that pellagra does not always produce, if indeed it ever does produce, a truly systemic disease of the central nervous system; but that the degeneration is caused by some toxic or infectious substance affecting all parts of the cerebrospinal axis, producing cellular degeneration and diffuse degeneration of nerve fibers in the posterior and anterolateral columns. It is not difficult to explain the mental symptoms when cortical degeneration is so intense as may occur in pellagra, and as is seen in the brain I have studied; and the insanity of this disease seems to be of a toxic or infectious character.

The constant involuntary movements of the limbs described by Dr. Anderson, and present also in Dr. Hall's case, are suggestive of the similar movements in strychnine poisoning. In pellagra the degeneration of the cells of the anterior horns probably causing irritation in the muscles innervated by them, the impairment of cerebral inhibition produced by partial degeneration of the pyramidal tracts, and the incoördination produced by the partial degeneration of the posterior columns, the cerebellar tracts, and the cells of Clarke's columns, may all assist in causing involuntary and constant movement. It is sometimes forgotten that holding the hand still and extended is a very perfect form of movement, requiring the degree of tonicity in the flexors and extensors of the limb exactly sufficient to maintain this position.

The spinal pia was considerably thickened in the second case, which was of long duration, but the thickening of the pia was not observed in the first case.

DISCUSSION

Dr. M. B. Hartzell: It is a matter of some interest to know that the pigmentation so often a symptom of pellagra is not confined to the skin, but is seen in the meninges of the cord and of the brain.

CONCERNING NERVOUS DISTURBANCES FOLLOWING SURGICAL OPERATIONS AND ANESTHESIAS[1]

By S. WEIR MITCHELL, M.D.

As I had the honor to suggest to the President of the College the subjects for present discussion, I am naturally interested, although I must frankly say that I am not prepared to contribute much knowledge in regard to the matter in hand, and rather await the information which I expect from the distinguished surgeons and physicians who are to take part in this discussion.

If I comprehend aright, it is proposed to consider tonight the *before* and *after* of surgical procedures. All surgical action which makes a wound invites the invasion of hostile germs. We know, however, that this is a matter of degree, and that large openings involve larger risks, and that there are certain operations (rectal and vesical) which we cannot completely condition with antiseptic precautions. It then becomes a vital question how far the bodily state of the patient may favor the hostility of the small or large number of germs which enter through gaps in the skin, or how far perfect health may, and probably does, continually defeat the hosts of minute death-bearing foes who surround us and await opportunity.

Returning home quite too late to consider these matters at length, I saw for the first time the statement of the limitations imposed upon the debate we hope to have this evening. It requires consideration on your part of cases of mental disorder following operative procedures. I feel, however, that the wider range I

[1] Read November 2, 1910.

should ask it to take would not exclude neurasthenic conditions which are or may be postoperative, for it is the opinion of one school of neurologists that all neurasthenias are wholly mental disorders. I need hardly say that this is not my opinion, but I do believe that most neurasthenias are accompanied by more or less of such mental disturbances as brings the whole matter within the reach of our discussion tonight.

Operative cases may come to the table, recover rapidly, get up, and be discharged with the label of "cured." But then soon, or after a month elapses, the patient develops some form or other typical of the so-called neurasthenias, which in our ignorance I like better to call in a general way asthenias. Was the operation alone responsible for the conditions which followed it? There is here ample opportunity for a fallacious interpretation of the origin of the postoperative sequences. The asthenic state may really have preceded the operation, been enormously relieved to appearance by the temporary uplift of a successful surgical procedure, by the sense of escape from peril, perhaps by the relief from pain and distress. This false sense of well-being may then give place, after a month, to a return of the asthenic state which the operation had only seemed to relieve. Here lies the possible fallacy.

But this is not all. It does certainly happen that, given a patient in a practically normal condition, where no very apparent need exists for precedent treatment, the operation may be followed after a month or more by serious asthenic states, which create for the physician a lasting case.

Another matter which is included in your program I shall put before you briefly. An unrecorded amount of mental disorders follows at times upon even slight surgical operations. The frequency is a matter for inquiry, and perhaps statistics may have accumulated beyond my knowledge. An interesting question occurred to me many years ago, and is in part my reason for suggesting this discussion. I asked myself whether the use of anesthetics has anything to do in bringing about the mental disorders of which I speak. I am old enough to have seen the last operations without anesthetics and the first under them, and I have searched

the literature in vain to discover cases of mental disorder in days when pain attended every operation. But case-taking in those days was not what it is now, and there is some evidence which will be brought before you tonight that anesthesia alone occasionally produces grave mental disturbance, which cannot very well be laid to the knife of the surgeon. I myself know of cases of this kind.

At times the neurotic, after minor operations, such as the pulling of a tooth or some trifling accidental injury, becomes the subject of a more or less grave hysteria. That is familiar and obvious. In some cases known to me, persons who have taken gas to have teeth pulled have been temporarily, for a few days, mentally disturbed. Some hysterical patients are, to use an illustration, like a gun already loaded. The surgeon merely pulls the trigger; but with proper care he might possibly have learned that the gun was loaded.

The graver mental disorders which may follow surgical procedures constitute the more difficult problems.

Of course, all this—and I have been as brief as possible, meaning to get rather than to give—all of this, I say, leads up to two questions: Is it not desirable in many cases to prepare the patient for operation more often than our surgical brothers seem to think is needed? The satisfying sense of minimum mortality is constantly and temptingly before them. What I want to impress on you is that not only the risks of death are to be considered in operations, but the possibility of increasing a precedent condition of disease or of manufacturing a sequent state of malady. I think that many physicians have felt with me that there is some necessity for more strictly dealing with the before and after of surgical cases.

I said that I would contribute little or nothing, and I shall limit myself to one suggestive remark concerning the effect on bodily resistances caused by diets. For illustration, I want to point out the extraordinary effect on the irritability of the bladder produced by strict milk diet. In support of this, in an old thesis of mine, I conclude with the statement made by Sir James Paget in talking with me many years ago, that so satisfied was he as to this point, that he never did a grave operation on the bladder without putting the patient under a fortnight of milk treatment, if he would bear it

at all. Here is surely a matter untouched by laboratory study. Wherein lies the value of milk—what does it do?

I am a little tempted—and this is to the address of my surgical friends—to say that no operation ought to be done without obedience to the rule which prevailed in St. Bartholomew's Hospital in William Harvey's day, that no surgeon should operate on a patient except after consultation with two physicians. I do not know that I would be severe enough to insist on two.

I have here put on paper to surely make it brief all that I mean to contribute to the subjects which are to interest us tonight.

POSTOPERATIVE PSYCHOSES[1]

By J. G. MUMFORD, M.D.
BOSTON

Some years ago I had occasion to look up a large consecutive group of patients operated upon at the Massachusetts General Hospital seven and nine years previously. The purpose of this research was to ascertain what might be their mental condition in relation to their operations, and their present effectiveness as compared with their effectiveness previously. The result of this research impressed me with the fact that we, as surgeons, are regarding too little, perhaps, that condition which Goldthwait has called the ultimate prognosis.

The experienced surgeon of reflective temperament probably considers the psychic elements in his cases, but I doubt if we are aware always how deeply significant those elements may be in controlling the return to health of a surgical patient. Rather are we wont to accept the patient from the hands of his physician, to shrug, perhaps, at what we are pleased to call his neurotic state, to proceed with the operation if the obvious lesion warrants it; then, with an anatomical cure established, to shift the patient back upon the weary physician for the tedious struggle to health. I do not maintain that we should refuse to operate upon such discouraging cases; on the contrary, I believe, as Dr. White long ago taught, that such operations—the operation *per se*—do great good and are important therapeutic agents. My thesis is that we should appreciate clearly the types of individuals liable to suffer from post-

[1] Read November 2, 1910.

operative psychic disturbances, and the surprisingly large number of such persons, and that we should perform the operations with intelligent purpose; and, most of all, that we should recognize our ability to aid in the after-treatment and should bear our share of its responsibility.

A competent and experienced dentist has recently stated that he can do little efficient dental work, on his best or most courageous patients even, within the year after they have experienced any surgical operation. Their psychic equilibrium is so unsettled that they shrink from the slightest manipulation, and must be carried over the year by mild palliative measures.

Let us consider for a moment the significance of certain clinical terms. What is the meaning of the words *cure, anatomical cure, psychical result?* I take it that a cure is the important end of all therapeutic endeavor. A perfect cure is the *summum bonum,* but is it not true that a large proportion of our cures are relative only? The man with a disabling recurrent appendicitis is absolutely cured of all pain and digestive disturbance through the removal of his appendix; the man with gangrene of the foot is relatively cured by amputation, though he be left maimed and halting; the woman with an ovarian cyst enjoys an anatomical cure when the tumor has been excised, and the wound has healed kindly and soundly, though an unessential organ has been removed. All these are clinical cures, are cures from the operator's point of view; but just here there enters into the problem an element of wide-reaching metaphysical significance. The ills of life, like all the so-called facts of life, are in direct relation and are proportionate to our experiences. The man who has just lost his appendix, if he lacks poise and clear vision, feels that he has been through a grievous crisis, that he has suffered a great cruelty in the operation, that the sanctity of his vitals has been violated, and that he can never again be what he was. Many persons hold that view, I find. The man who has lost his foot may find little comfort in his freedom from pain and impending death; his old life is gone; he must readjust himself to new circumstances of existence; his relations to his environment must be re-cast; he must limp, a cripple,

through the remainder of his life, bearing with him an unsightly stump and a grievous scar to fret and distress him. The woman whose ovary was removed, useless though that ovary may have been, believes herself to have been unsexed. She has heard tales of changes in temperament, of coarsening features, of mannish tendencies; or perhaps she thinks a full set of ovaries essential to sound health and the bearing of womanly cares. She looks forward to some mysterious, ill-defined change in herself, or to invalidism, and the reassuring farewell words of the surgeon fail to turn her from the expected melancholy course. Strong character and optimism are needed to overcome these tendencies, unless aid be brought from outside sources.

How, then, shall we define a *cure?* I protest that a cure consists only in returning a man to that state of physical and mental health which shall enable him to live his life, to accomplish his wonted work, to adapt himself to his environment in vigor of body and freedom from pain, with his normal functions undisturbed, with his mind unclouded, buoyant, assertive. That is the perfect cure, but it is a cure not easy of attainment. A more common and reasonable cure is a state of relative comfort and efficiency, with little pain and distress, with infrequent anxiety, with renewed, if imperfect, confidence in the bodily powers.

By the term *anatomical cure* we imply a sound wound healing and a restoration of the bodily functions, so far as such restoration may be compatible with the loss of, or damage to, members or organs.

Psychical results are related to the subjective mind. Their bearing upon the cure concerns the patient, not in proportion to anatomical perfection or to potential physical and intellectual capacity, but rather to what he himself finds to be his perfection or capacity; and just in so far as his objective intelligence is feeble, or has become enfeebled, just so far is he fated, on the one hand, to remain a wreck, or, on the other hand, to refit his shattered being. We must teach ourselves to look to the ultimate prognosis. It is not what we are, it is what we think ourselves to be. That is the sum total of the old argument.

I have mentioned the enfeeblement of the objective intelligence. Such enfeeblement has commonly been referred to as a neurotic condition, and has been regarded commonly as a state of mind for which the patient is in large measure responsible. In the language of the street, we speak of such persons as lacking in nerve or in pluck, and we are wont to assume toward them an attitude of more or less modified contempt. I believe that such an attitude on our part is in many instances unjustified, and that through the researches of Crile and his associates we may find excellent anatomical reasons for this depressed mental condition. It would be unprofitable for me here to rehearse the striking and interesting experiments conducted in Crile's laboratories, but one may profitably glance at and sum up some of his conclusions. In a word, he finds that both animals and human patients, the victims of both *mental* and *physical* assaults, suffer quite similar degenerative changes in the structure of the nerve cells in all parts of the brain, and in their reaction to the Nissl stain as well. These changes in the nerve cells include changes in the absolute size of the cells, in the size-relation of the nucleus and plasma, in the membrane surrounding the cell, in the membrane surrounding the nucleus, and finally in the general contour of the cell itself. The cell increases in bulk—from a slight variation to eight times the normal even. In the normal cell there is a definite relation between the size of the nucleus and the remainder of the cell. After operative assault or mental shock the nucleus becomes relatively larger. In the normal cell the surrounding membrane, as well as the membrane surrounding the nucleus, always presents an unbroken continuity. After assault these membranes may be extensively ruptured, so that the cell becomes greatly distorted. In extreme cases the cell loses completely its contour, and presents the appearance of a disorganized mass of protoplasm. Furthermore, there are certain notable changes in these cells in their relation to staining. When first assaulted they show an increase in the amount of the Nissl stain which they are capable of absorbing; later, as the degree of shock is increased, the amount of reaction to the stain diminishes, so that in the final stages little or no staining is found. Crile

observes, however, that in fatal cases even, *all* of the cells are not invariably thus altered.

Observe, then, this striking conclusion: On morphological grounds, when shock has broken down the nucleus, the nucleolus and the cell body, so that there remains a mere mass of protoplasm, we must regard the cell as almost certainly dead and incapable of regeneration. The gravity of any physical or mental assault in a given case is indicated, accordingly, by the percentage of brain cells which are thus broken down and virtually killed. The damage done by purely physical trauma is manifest in the destruction of cells in the cortex, in the cerebellum, and in the medulla; the cells of the spinal cord are modified little or not at all.

Hertwig, Howard, and others, in their studies of unicellular organisms, have shown that in fatigue, overwork, and starvation the principal gross change in the cell is in the nuclear-plasma relation. Crile and his workers have shown that after various physical damage and disease the brain cells obey the same law of change. They find the same changes present as the result of overwork, anemia, infections, drug poisons, shock, fear, and anxiety. In acute anemia—and the same is true of fear, fright, and worry—we find brain changes varying from temporary hyperchromatism through every change down to the death of the cell itself. The potential energy of the cell is soon used up. If the effort of the organism does not result in an efficient circulation through the brain and in consequent re-stimulation of the cell, the patient must suffer collapse, permanent impairment, and even death. This is a fact of great clinical importance.

Allow me to rehearse an instructive laboratory operation on the intestines by Crile, which resulted in extensive damage to the cells of the cerebral cortex. One can well see that such secondary damage to the cortex may result in prolonged, or even in permanent, impairment of the intellectual and moral vigor of the individual. In a study of intestinal gangrene, Crile found that after a certain number of hours of total exclusion of the blood supply, the intestine became gangrenous On his releasing the obstruction the animals

soon died, even with the reëstablishment of circulation. If the circulation was not reëstablished, the animals died also, but later. Even when a preliminary entero-enterostomy had been made, and the isolated coil of intestine was used for the experiment, still death occurred. As a rule, there was no peritonitis, and death took place in from twelve to twenty-four hours. If a complete resection of the gangrenous segment were made, nevertheless death occurred in about the same time, but by his making an external drain in the loop of intestine he saved the animal. These results were explained at once by injecting a very small quantity of the juice of the gangrenous coil subcutaneously into a sound animal. Even when the material was injected by a hypodermic needle into the lumen of the uncontaminated bowel, serious illness or death followed, the symptoms being precisely those which resulted from resection for gangrene of the bowel in man. As the experimenter remarks, the coincident widespread impairment or destruction of the animal's brain cells told the entire story. Undoubtedly, even at the time of operation in man for gangrene of the bowel a sufficient amount of toxins has already been absorbed and fixed in the brain cells to cause death; or, if there have not been toxins enough, death is made more certain through the amount of poison squeezed into the circulation by manipulation of the gangrenous gut. Patients become severely ill, or die, or remain neurotic invalids, not through the immediate damage to the traumatized part, therefore, but through the more or less permanent damage to the cerebral cortex as the result of the absorption of toxins.

Such an experiment as this suggests the role which infection plays in limited surgical risks. It explains also the slow convalescence in cases of ruptured appendix, with peritonitis, as compared with clean cases. Is it not probable, therefore, that the gross lesions in the abdomen are of less importance to the patient for life or for perfect recovery than are the microscopic lesions in the brain?

We have seen, and our experience teaches, that many persons subject to physical and mental assaults—to what we call traumatism and to shock—receive serious mental impressions which can

be demonstrated clinically through searching our records, and can be demonstrated anatomically through the examination of the brains of experimental animals and of patients who have died as a result of some form of physical or mental shock.

The clinical evidence of disturbed mental equilibrium is familiar to all surgeons, and my researches show me that such mental disturbance is especially liable to ensue after operations on the generative organs of both men and women, when those organs have not been actually removed, but have been so tampered with that the patient lives on in dread of their loss at some future time. For example, operations for varicocele and hydrocele are followed by more pronounced and prolonged neuroses than is the operation of orchidectomy. The operations of suspension of the uterus or repair of the perineum frequently leave behind them trains of mental depression more serious than do the operations of ovariotomy, or even of hysterectomy. The explanation in these cases seems to be that those persons deprived of important organs are able to readjust themselves to a positive calamity more readily than are those patients who continue an existence of anxiety regarding a possible future calamity.

A series of investigations by Crile is now in progress on the effects of disturbed functionating of the ductless glands, and so far as this investigation has gone we seem justified in assuming the hypothesis that the ductless glands—the thyroid, the hypophysis, the suprarenals, and the ovaries—when overstimulated, bring about directly a disturbance or partial destruction of certain nerve cells of the brain. We are familiar with the fact that the ductless glands are capable of stimulation through what we call mental impressions, so that, to take a concrete example, we illustrate the circle in some such fashion as this: excessive fright or anxiety may be the initial cause for a development of the thyroid leading to Graves' disease. Graves' disease results in a more or less continuous intoxication of the whole organism. These toxins bring about a progressive disorganization of certain nerve cells in the brain, and the more advanced becomes this disorganization just so much the more long-continued or permanent becomes the depressing effect upon what

we call the mind, as well as upon the functions and the physical capacity of the individual.

In view of this situation, it behooves surgeons to provide in every possible way against adding physical and mental traumata to their patients. This proposition in itself opens a field of wide speculation and interest, and of the greatest practical importance. We must endeavor to guard against mental shock by surrounding the patient with appropriate psychic influences, and to guard against physical shock by limiting our operative manipulations to the least possible traumata of the parts involved, and we must employ our anesthetics judiciously and appropriately. Our conduct of convalescence must be made more painstaking, more optimistic, and more prolonged. We must impress upon the patient the certainty of his return to perfect health; we must eliminate a needless repetition of painful dressings, which so frequently lead through summation to a depressing dread of the surgeon's visit; and, after the wound is healed, and the patient leaves his bed, we should continue, through ourselves, our associates, or the patient's family physician, a constant and sustained attitude of optimism and encouragement to take up and practise the familiar duties and experiences of a well-regulated and normal life.

THE DIAGNOSIS OF POSTOPERATIVE INSANITY[1]

By JOHN CHALMERS DA COSTA, M.D.[2]
SAMUEL D. GROSS PROFESSOR OF SURGERY, JEFFERSON MEDICAL COLLEGE

All sorts of mental disturbances may follow a surgical operation. Among these disturbances we should mention delirium; hysterical excitement; obsessions, especially morbid fears; illusions; hallucinations; amnesia; confusion; impulsions; hypochondria; melancholy, and actual insanity.

It is certain that genuine insanity may arise after an operation. There are many cases on record. It is, however, seldom met with. Of 1000 laparotomy cases, 4 will probably go insane. If we exclude from consideration removal of, or operations upon, the ovaries, insanity is no more frequent after abdominal than after other operations. If we exclude oöphorectomy, orchidectomy, other operations on the genito-urinary organs, and brain operations, there is no special element in a particular sort of surgical operation to cause insanity. A brain operation directly, and perhaps grievously, damages the brain, but in spite of this is seldom followed by insanity. The removal of the ovaries induces a sudden menopause and deprives the organism of the internal secretion of the ovary, which is probably of value to the nervous system. The menopause is always a peril to the mind, and a sudden is more perilous than a gradual menopause.

[1] Read November 2, 1910.

[2] Years have passed since the writer served as one of Dr. Chapin's assistants in the Pennsylvania Hospital for the Insane. During those years the nomenclature and classification of insanity have been greatly changed. Hence, in this paper terms are used which will meet with the just criticism of alienists. My excuse for this paper is the excuse the nurse made to Mr. Easy when charged with having had an illegitimate child She said: "But it was such a little one."

Mental disturbance is common after orchidectomy, even in old people, and is probably in part dependent on the removal of an organ which furnishes an important internal secretion.

Postoperative insanity is more common in women than in men, and less common in children than in adults. A trivial surgical operation is just as likely to be causal as is a mutilating procedure.

The elements connected with a surgical operation that make it a possible cause of insanity are as follows:

The patient may have long suffered from fear, pain, insomnia, or exhaustion; he worries before and usually takes a general anesthetic at the time of operation. The operation produces shock and loss of blood, and the anesthetic may poison him. After the operation there may be postoperative pain, insomnia, anxiety, fear, and homesickness.

In all cases of postoperative insanity there is predisposition, hereditary or acquired. There was long preparation of the patient or of his ancestors. The operation (and its elements) constitutes only an exciting cause acting on a predisposed nervous system. Such individuals were in danger of insanity before the operation was performed and would have probably gone insane anyhow, sooner or later, when exposed to the chances, the changes and the worries of life, even had no operation been performed. A normal, stable, healthy brain will probably never go insane after an operation unless that operation attacked the brain, removed the testicles or removed the ovaries.

In many cases the predisposition is hereditary. In others heredity plays no part, or at least cannot be shown to be a factor.

Some of the reported cases of postoperative insanity were actually on the eve of an outbreak or were really insane when the operation was performed, the mental condition having escaped recognition, and having grown rapidly and gravely worse after operation.

Insanity may come on immediately after the operation, and should it do so the anesthetic may usually be regarded as the most active exciting cause. In these cases, according to Savage, the patient is insane on waking from the anesthetic sleep. I have never seen such a case. Postoperative insanity not due to the

anesthetic comes on usually in from three days to two weeks after the operation. An acute insanity comes on usually in from three to five days. States of fixed and limited delusion may come on much later than two weeks after operation. If a person has ever been insane an operation exposes him to very distinct danger of another outbreak, and on such a patient only an operation of necessity is justifiable. If any other sort of operation is decided upon, the risks should be explained beforehand to the patient and the family. Operation on an insane person may leave him unchanged, worse, or better mentally. Accurate prediction as to what is going to happen is impossible. There is no special mental condition characteristic of postoperative insanity. There may be mania, melancholia, stupor, or a delusional state, but the commonest condition is acute confusional insanity. This confusional state is characterized by confusion of thought and incoherence of speech, delirium, usually illusions, and hallucinations sometimes changing delusions, almost always revery, and occasionally stupor, but there is not the real emotional exaltation of mania or the real emotional depression of melancholia. The delusions of confusional insanity are called by Grasset dream delusions. They flit and change and are as fragmentary and unsubstantial as the images of a dream. The two most active causal elements of insanity which are associated with a surgical operation are *fear* and *worry*. That fear is a very powerful depressing emotion is certain. Many known facts show its power. It can sober a drunken man; can make the milk of a mother poisonous to a baby; can cause jaundice, diabetes, epilepsy, chorea, miscarriage, temporary paraplegia, aphasia, paralysis agitans, catalepsy, loss of speech, loss of sight, syncope, grayness of the hair, and even death.

Cases illustrating these various happenings are on record. When fear can do all of these things it scarcely surprises us that it may cause insanity. In fact, an ante-operation fear may become a postoperation phobia. And yet I do not believe that fear (or its acute and sudden manifestation, fright) is often responsible for insanity. Most people, if badly frightened, refuse operation. It is my experience that most people go to the operating-room with

reasonable calmness, many of them with heroic firmness and determination, some of them with actual satisfaction at the prospect of being freed from a loathsome disease, a torturing pain, or a condition threatening life.

Worry before the operation is a very common antecedent of postoperative insanity.

Many victims of postoperative insanity were terribly worried and depressed for a long time before operation, dreaded and shrank from operative treatment, but finally accepted it or were urged into it. Some came to operation expecting to die. Many markedly magnified the anticipated pains and perils. Many of these victims of postoperative insanity for a long time before operation had poor appetites; were sleepless, constipated, and hysterical; suffered from indigestion; lost much weight, and failed in resisting power. When such a subject of anxiety comes into a hospital, he or she is unreasonable, irritable, suspicious, and exacting, and is apt to be very homesick. Such a person is certainly to some extent predisposed to insanity and is especially predisposed if there be a morbid heredity. In one so predisposed, a shock, loss of blood, any toxic influence, any exhausting factor may be the last touch which finally overthrows the mental balance. Many persons worry but not to a degree to predispose them to mental disease. A worried patient *not* predisposed to insanity by heredity or by acquired weakness is apt to recover a healthy mental level very soon after operation. The operation once well over, a pall seems lifted from the spirits, and worriment usually promptly ceases. In a person predisposed to insanity, by hereditary or acquired weaknesses, there may be no rally even after the successful completion of an operation, and the mental disturbance of anxiety may deepen or be translated into actual insanity.

Postoperative insanity is practically identical in nature and mode of genesis with puerperal insanity. Septic cases, other things being equal, are more liable than aseptic cases.

Conditions That May Be Mistaken for Insanity. *Delirium.* The term delirium denotes a state of mental excitement, sudden in onset, temporary in duration, and due to some adequate

and usually recognizable cause. It is a symptom of many diseased conditions. This disordered and excited condition of mind differs in no essential manifestation from some acute insanities, but it is customary to restrict the term delirium to the mental state sometimes met with in certain intoxications, in many infections, in conditions of great exhaustion, in states of great emotional instability (as hysteria), and in organic disease of the brain or its membranes. Delirium is far more common from intoxication or infection than from organic brain disease. The surgeon sees it in septic cases.

Most of the general diseases productive of delirium are febrile, hence the term "febrile delirium." It is by no means certain that the elevated temperature produces the delirium. Both the delirium and the elevated temperature may be products of a common cause. In delirium a patient is out of relation with his surroundings and memories. "Mental processes are not in accordance with sense impressions and there is no consciousness of the discrepancy."[1] A delirious patient is restless, sleepless, talkative, and incoherent. He has a rapid pulse and usually fever, and is the victim of illusions, hallucinations, and delusions. The delusions are unsystematized, and rapidly changing, resemble dreams, and in some cases arise from dreams. A dream delusion may pass into an obsession and be carried well into convalescence. Gowers points out that certain features common in insanity seldom occur in delirium. "Such are the extreme and persistent emotional depressions of melancholia, the exaggeration of idea that is common in general paralysis, the outrageous delusions of personal identity met with in some cases of chronic insanity, and the rhetorical loquacity of acute mania."[2] A man already insane can become delirious, and delirium may usher in an attack of insanity; hence a septic delirium may be followed by insanity. We are considering delirium arising in one previously sane. Delirium in the sane is usually of more sudden onset and of briefer duration than delirium in the insane. An accurate history is of great importance in founding a judgment regarding a delirious patient.

[1] Lectures on Diseases of the Brain, by Gowers.
[2] Ibid.

Febrile Delirium. If a patient with fever is delirious and the delirium is due to the fever, it will always be found that the fever began before the delirium. If delirium preceded the fever, it obviously could not be due to the fever.

So-called febrile deliriums may perhaps in some cases be due purely to elevation of the temperature, and in others to disturbances of cerebral circulation, but in the great majority of cases it is due to poison circulating in the blood.

We often see a patient with high temperature entirely free from delirium. We sometimes see a delirious patient with but trivial elevation of temperature. Some people become delirious from slight causes, and temperament seems to notably influence the liability to delirium. Children and aged persons are apt to become delirious even when the temperature is but moderately elevated. It is rare, however, to see delirium when the temperature is less than 102°, unless kidney function is much impaired. This may mean that it usually requires an intoxication or infection of sufficient intensity to raise the temperature to 102° to induce delirium. The delirium of fever is usually moderate, but may be active. In some fevers it is of the form called "mutterings." Delirium in pneumonia is usually violent.

Febrile delirium is apt to make its first appearance in the evening, when the patient is between sleeping and waking. It may clear up when he gets wide awake, to occur again with drowsiness. It may endure through the night, pass away in the morning, and reappear later in the day. In many cases it becomes continuous, during the night and day. An outbreak of acute mania may be confused with febrile delirium, but in mania the onset is seldom as rapid. Mania in the beginning is usually afebrile, and may remain so. Even when the temperature is raised in mania the elevation seldom exceeds 1°, except in that state of raging and tumultuous excitement called acute delirious mania. In febrile delirium the temperature is practically always 102° or over. In acute mania we do not have a happening which is quite common in febrile delirium, that is, the complete clearing away in the morning of all signs of the mental trouble which were so manifest in the night.

Maniacal excitement may grow better or worse over and over again, but it is there in some degree until the mental exaltation is over. A true lucid interval is unknown out of the testimony given in the witness-box. The onset of delirium differs from the onset of mania. In the vast majority of instances, delirium is brief and mania is prolonged. What is known as a transitory mania may last from a few hours to a day or two, but this condition is almost limited to youth, and it begins with explosive suddenness, in a subject highly predisposed to nerve storms. The majority of these subjects are epileptics. Transitory mania ends as suddenly as it begins. It may be awakened by a fever, by fright, by any emotional excitement, or by severe mental strain or worry.

The man with febrile delirium is usually an obviously sick man —sick, that is, from some bodily malady.

Acute delirious mania may be confused with febrile delirium, because the sufferer from acute delirious mania is always ill and develops high temperature. His tongue is dry and coated, and there are sordes on his lips and teeth. But acute delirious mania is an evolution from, or an aggravation of, ordinary acute mania, and ordinary acute mania precedes delirious mania. The high temperature, the physical illness, the total unconsciousness of the surroundings are apparently as after-thoughts. They are added to an ordinary mania. Hence it is obvious that the onset of acute delirious mania differs from the onset of febrile delirium, and each possesses certain distinguishing features.

There is no possibility of confusing febrile delirium with melancholia, stupor, or delusional insanity. These three conditions are afebrile, are prolonged, are usually gradual in onset.

The febrile attacks of paresis are associated with convulsions.

Confusional insanity may be readily mistaken for febrile delirium. The analysis of the mental state of a delirious patient shows that delirium is identical with confusional insanity. Acute confusional insanity may arise rapidly with fever, but it is more common after a febrile malady than during it. Elevated temperature in confusional insanity is not prolonged unbroken. It comes, if it comes at all, in temporary episodes. Confusional insanity is

largely devoid of real emotional depression or exultation. It may last but a few days, but is usually of much greater duration. Febrile delirium may be mistaken for the delirium of organic brain disease with fever. The headache of fever ceases when delirium begins, the headache of organic brain disease continues in spite of delirium. In brain disease, delirium may precede fever; in febrile delirium, fever always precedes delirium. Certain well-known symptoms, if present, indicate brain disease. It is not necessary to dwell upon them in this paper.

Delirium Tremens. All surgeons know that a regular drinker is liable to develop delirium after an operation or accident or with the beginning of pneumonia. The man is not of necessity a drunkard. He is a regular hard drinker, usually a spirit drinker, but he may never have been in the habit of getting really drunk.

If such a subject is injured or operated upon he is apt to have an almost sleepless night, the brief episodes of sleep, if such occur, being filled with horrible dreams. Day finds him restless, nervous, shaky, suspicious, and apprehensive. He has an absolute loathing for food, and, in some few cases, for alcohol, but usually he craves alcohol. Hallucinations, like the dream hallucinations of the night, come to him now even in waking moments. For a few hours he may fight them down, but they eventually possess him. The condition just described is called the "stage of horrors," and many cases are arrested at this point. In other cases, before many hours, uncontrollable, vivid, and dreadful hallucinations dominate the perceptions, actual delirium begins, and great general tremor arises. The limbs tremble, the head shakes, the face twitches, the tongue quivers. The patient cannot keep still for a single moment. He tries to get up, picks at the bed-covers and his night-dress, wants to start at once for anywhere, just to get away from the horrors of the place he is in. His mind is in a chaos of ever-changing and riotous ideas. He is in a condition of dreadful, of abject, fear. He talks constantly, and his talk is a combination of delirious ideas and fanciful notions of things and people about him. For a time he remains able to recognize those about him, but soon ceases to, and then all are regarded as dangerous and

implacable enemies seeking his destruction. For a time he can by effort answer simple questions correctly, but this power soon ceases. He may fight. He may injure others, as a cornered rat fights for life. He may injure himself in efforts to evade his persecutors. He is in a condition of panic terror. He moans, mutters, curses, babbles, shouts, or prays. He looks fearfully about, suspicious of everybody and of everything, and listens furtively to hallucinatory voices. In this stage he is obviously physically ill. He is entirely sleepless, perspires profusely, and is very tremulous, but the tremor abates somewhat as the delirium increases. The tongue has a heavy white coat and the pupils are dilated. This condition of fright delirium with tremor lasts from two to four days, then, in a favorable case, the patient goes to sleep and wakes free from hallucinations and delirium, but extremely tremulous and much exhausted.

The diagnosis of the condition is marked by the history of the patient, the mode of onset, the tremor, the physical condition, and the self-limitation of the trouble.

Deprivation in a Morphine or an Opium Habitué. An opium or morphine habitué who has been operated upon or injured by accident and then deprived of his accustomed drug may develop delirium with tremor. Morphine users are as great liars as some explorers and many statisticians. They seldom tell the truth, and when they do it is more by accident than design.

Now and then a surgeon undertakes an operation on a morphine "fiend," not knowing that he is a "fiend," as the man has never mentioned his vice. Later, delirium arises, and for a time its cause may be quite inexplicable. In doubtful delirium the surgeon should conduct a careful examination of the patient to see if there are upon him scars from the use of a needle. Of course, the patient may have taken opium by the mouth and may not have used the needle.

In delirium from the deprivation of morphine or opium the patient is sleepless, restless, and very tremulous. There are complete anorexia, diarrhea, widely distributed and severe neuralgic pains, and rapidly growing exhaustion. Sometimes there is inex-

plicable fever, or a chill and fever. The patient is highly emotional. Hallucinations are common, but are seldom so dreadful as are those due to alcohol. Women particularly exhibit hysterical phenomena. Delirium occurs in most habitués when the drug is suddenly stopped. As the delirium increases the tremor gets worse, exactly the reverse of what happens in alcoholic delirium tremens. Delirium due to opium or morphine deprivation can be arrested at any minute by a generous dose of morphine. If this is not done, the delirium lasts from twenty-four to thirty-six hours, and then the craving is irresistible, and even the most secretive victim begs for the drug.

Excitement from a Dose of Morphine. A patient of mine was brought into the hospital and operated upon for neuroma of a stump. The day after operation he was much excited. The eyes were bright, the face flushed, the conjunctivæ injected, the pupils moderately contracted. He was talkative and decidedly incoherent in his ideas, his speech was somewhat thick, his mouth was obviously dry, and his voice was husky. After two hours of this condition he went into a deep sleep, from which he awoke weak, pale, and very tremulous. An examination of his effects disclosed the cause of the excitement. His handbag was under his bed; it contained a false bottom, and beneath this there were dozens of bottles of morphine tablets. He had taken a quantity of morphine, and the drug caused delirium before it induced sleep.

In every unexplained case of delirium think of the possibility of morphinism and search for the drug. The same rule should be followed in every case of unexplained fever or chills and fever.

Cocaine Delirium. I have seen a number of cases of cocaine poisoning, and several of them were very alarming. Poisoning is especially apt to arise when cocaine is used in the urethra or is injected about the face. Toxic symptoms arise during or soon after the operation. In the mild cases there are pallor, dilated pupils, dry mouth, excitement and great talkativeness, rapid respiration, restlessness, weak pulse, tremors, and often elevation of temperature. The patient talks like one intoxicated with alcohol. The symptoms of poisoning seldom last beyond two or

three hours, but when they pass away the patient is left weak and tremulous. Usually he is sleeepless the night following the attack.

In more severe cases of poisoning there may be syncope. There are usually loquacious delirium, elevated temperature, and a tendency to death by respiratory failure or by tetanic fixation of the respiratory muscles. Convulsions may arise. The delirium is usually manifested by rambling incoherence. A patient may think he is engaged in the work of his calling. A telegraph operator poisoned with cocaine telegraphed for an hour on an imaginary key. Sometimes there is mental brightness. A patient of mine quoted Keates' "Ode to a Nightingale," and told me that "a drowsy numbness" filled his veins. The diagnosis of cocaine delirium is clear because the cause of the condition is obvious.

Delirium from Iodoform Absorption. Iodoform may be absorbed from a wound and produce toxic symptoms. Elderly subjects are particularly liable to absorption. The condition is often mistaken for sepsis, but in iodoform poisoning the wound looks healthy; in sepsis, it does not. Iodoform poisoning is sometimes mistaken for insanity.

In acute cases the symptoms arise suddenly two or three days after the operation. There are elevated temperature, nausea, watery eyes, yellow conjunctivæ, contracted pupils, running of the nose, a metallic taste in the mouth, yellowishness of the skin, and the odor of iodoform on the breath. The mental condition is a state of hallucinatory delirium. In many cases there is an erythematous skin eruption, or an eruption resembling measles. Petechial and vesicular eruptions have been reported. Usually nephritis exists, and there is invariably rapid loss of flesh and strength. Finding iodoform in the urine makes the diagnosis clear. Many of these cases pass into coma and die within a week. The chronic form of iodoform poisoning is sometimes encountered, and the real cause of the condition is frequently overlooked. It is not unusually confounded with insanity. A woman had a sarcoma of the antrum. The right half of the upper jaw was removed. The cavity was packed with iodoform gauze. Three days after

operation she developed a condition supposed, at first, to be melancholia. It turned out to be due to iodoform. In these cases examination of the urine will disclose the presence of iodoform. A case of chronic poisoning begins gradually with suspicion, moroseness, irritability, and bewilderment. Then the patient becomes much depressed mentally and develops unsystematized delusions of persecution or delirious excitement. There may or may not be fever. Finally he may die in coma. I have seen several severe cases of iodoform poisoning. One, that was mistaken for measles with febrile delirium, died; the others recovered.

Delirium Nervosum. This is sometimes called traumatic delirium. It is a delirium without fever which is sometimes seen in very nervous persons after an injury or surgical operation. It only occurs in very nervous subjects and appears any time within five days after operation injury. In most cases the condition is a maniacal excitement; in others, there is confusion, revery, and a tendency to stupor. In all there are hallucinations, illusions, and delusions. The form with confusion and a tendency to stupor is in reality confusional insanity. The form with exaltation is usually mania. True delirium nervosum is a state of mental excitement which arises suddenly and terminates suddenly. It lasts several days or even a week. Most cases recover, but now and then a case dies. Never make the diagnosis of delirium nervosum until we have ruled out iodoform poisoning, hysteria, sepsis, uremia, acetonuria, the effects of morphine, and genuine insanity.

Delirium of the Senile. An old person, well along on the road of senility, may have been injured or operated upon. The surgeon may not have observed any grave signs or mental deterioration, and yet, soon after the operation, depression may develop, or mania melancholia, or a delusional condition may arise, precursors of senile dementia.

Many aged people are irritable, excitable, suspicious, restless, loquacious, and quarrelsome. About 10 or 15 per cent. of them sleep badly.

It is not unusual for a senile individual to develop nocturnal delirium after operation. This delirium may or may not be febrile.

In some cases there is a very trivial elevation of temperature. In others there is decided fever. In the morning the delirium may pass away permanently or it may recur the next night and on subsequent nights. It may become diurnal as well as nocturnal. In the delirium he is noisy, incoherent, inattentive to surroundings, suspicious, confused, and tremulous. He talks and shouts, is very restless, gets out of bed unless restrained and tries to wander off. He may pass his water in bed. He may have hallucinations of hearing, may be erotic, and may attempt suicide. Such delirious conditions, if not a part of a real senile dementia, soon pass away.

Hysterical Delirium. This condition may be due to pure fright or any violent excitement; to irritation, to worry or to overstrain. It is seldom seen except in young women and is most common at a menstrual period. Sometimes it is preceded or accompanied by hysterical convulsions, but it may occur without them. It begins suddenly. The patient becomes terribly excited and don't keep still a minute. She talks loudly and very rapidly, but seldom incoherently. She laments, implores, screams, and curses. She may laugh or cry. She is perverse and obstinate in the extreme, is apt to make indecent exposures or gestures, and to use profane and obscene words. The excitement comes in waves, and out of the turmoil of her delirium she may ask intelligent questions or show that she observes her surroundings. The entire attack has a curious appearance of unreality. The patient seems as though pretending to be out of relation with her surroundings. The excitement ends after an hour or several hours, often with an attack of tears. Sometimes it ceases when directions are harshly given or when admonitions are impressively uttered. After the attack is over, large amounts of pale urine are passed. Such a patient is apt to present the permanent stigmata of hysteria (contraction of the visual fields, areas of anesthesia, and hysterogenetic zones).

Diabetic and Uremic Delirium. When acetonuria exists, with or without sugar, an operation or an accident is liable to be followed by coma, and the condition for a few hours or even days before the onset of coma may strongly simulate confusional insanity. I have

seen three such cases. In every case of postoperative mental disturbance at once examine the urine.

Uremia may cause delirium. It may last for days or weeks. The state is usually one of restless excitement in an individual partially comatose. It is a drowsy and restless delirium. Convulsions may occur; twitching of the limbs is noted, and usually coma ends the scene.

Examination of the urine makes the diagnosis evident.

Among other conditions which may be confused with insanity are the following:

Delirium of starvation (which is sometimes seen in cancer of the stomach or esophagus); delirium of fatigue; delirium of collapse (as after fevers); mental conditions due to organic brain disease (tumor, meningitis, etc.); night terrors of children; nostalgia; epileptic mania; delirium after thyroidectomy (thyroid poisoning); delirium in the course of exophthalmic goitre; belladonna delirium; and the condition induced by the prolonged administration of large doses of bromide.

In every case of postoperative mental disturbance a careful history should be obtained, a thorough examination should be made, and an alienist should at once be called into the case.

In a vast majority of cases a certain diagnosis can be made, and it is vitally important that it should be made early. It will prove a dreadful and probably a fatal mistake to assume that a beginning case of diabetic coma is confusional insanity; that organic brain disease is causing mental excitement when pneumonia is the causal factor; that there is merely hysterical excitement when the real condition is cocaine poisoning; that the patient has febrile delirium when he is poisoned by iodoform.

Many sufferers from genuine insanity should be sent to a hospital for the insane. In fact, such a patient should always be sent there after sufficient delay has been obtained, to be sure that the attack is not of a transitory nature. A prolonged case cannot be cared for in a general hospital. But we must be *sure* he is insane before we send him to an asylum. To have been in an asylum gravely injures all of a man's prospects in life. It is a fine blunder

to send a victim of bromism to an asylum as a sufferer from dementia præcox. It is an equally fine blunder to keep out of an asylum one who may injure himself or others.

The entire subject of postoperative psychoses is extremely interesting and highly important. There remains much to learn about it.

The writer of this paper does not feel that he has shed light upon the obscurities of the subject. That remains for more experienced ones to do.

POSTOPERATIVE INSANITIES[1]

By EDWARD N. BRUSH, M.D.
SHEPPARD AND ENOCH PRATT HOSPITAL, TOWSON, MARYLAND

I FIND that I am laboring under a misapprehension upon my part. From the letter which was sent me I came to the conclusion that I was simply to discuss the paper of someone else—not that I was to present a paper myself—and it was only a few days ago that I learned to the contrary. I have thrown together certain headings, and in a discussion of them I shall crave your indulgence in lieu of a formal paper. I wish to say that I have learned this evening that a surgeon from Boston may be and ought to be regarded as a psychologist, and that a surgeon from Philadelphia is still a little lacking in his qualifications in psychiatry, possibly owing to the fact that I did not better instruct him in his youth.

The assumption, however, may be at once made, so far as postoperative insanity is concerned, that *per se* there is no such thing. Insanity follows operations, but it follows operations in various ways, manifesting itself in various forms. There is no one form of insanity that follows, for example, operations upon the pelvic organs of women, or the genital organs of men. In the consideration of the subject we are met by the fact—and Dr. Da Costa admitted the same thing in his paper—that the early symptoms and the personal and family history of the case are commonly badly obtained; that when we come to analyze, as I have tried to do in the last three or four days, a series of cases of so-called postoperative insanity, we are not at all sure as to how far heredity plays a role in the case, how far acquired mental instability plays a part, and

[1] Read November 2, 1910.

in some cases we are not sure the patients were not insane long before the operation which is supposed to have produced the insanity. This naturally arises from the lack of clinical experience in psychiatry on the part of many observers of these cases. Some time ago those of us who have spent many years in hospitals for the insane were told that every hospital for the insane ought to have a surgeon, an ophthalmologist, a gynecologist, and a neurologist on the staff. I trust that I may not be accused of a *tu quoque* form of argument if I say that it might be well to have on the staff of each general hospital a psychiatrist. Indeed, five or six years ago I made the suggestion to one of our best-known clinicians that the deliria of typhoid, pneumonia, etc., in his wards be studied by a medico-psychologist. I am sure there is a great field for the careful study of the ordinary deliria.

Then, too, before we can study very thoroughly or intelligently the postoperative sequelæ, we must have our histories a little more carefully recorded—not diagnosticated—but recorded as to symptoms. Too often we are told that the case is one of confusional insanity, etc., and have not the data upon which we can determine whether or not the diagnosis is correct. Therefore, we are in the position of not knowing very much about the insanities following operation.

Then, too, as has been intimated, there is lack of knowledge of the value of mental symptoms and physical signs, which leads to mental symptoms which become marked after an operation being attributed to the operation, when the patient was, perhaps, insane prior thereto. I have made an autopsy upon a case of paresis operated upon by a surgeon—I should say an "orificial" surgeon, whatever that may be—with the idea of curing certain symptoms which should have at once suggested paresis. The mental symptoms rapidly progressed after the operation and were attributed to it.

The etiological factors in postoperative insanity may be enumerated somewhat in the following order: (1) Heredity; as in case of other data, information upon this point, is the most difficult to obtain. (2) Mental instability, with no known heredity,

nascent dementia præcox, congenital or acquired imbecility, concealed alcoholic or drug habits. (3) Seat and nature of the operation, particularly operations upon genitalia. (4) Quite a large proportion of so-called postoperative insanities are due to sepsis, not necessarily, however, to faulty technique on the part of the surgeon. These cases are analogous to the so-called puerperal insanities, which are nearly always due to sepsis. (5) There is to be considered the anesthetic used—the ether, gas, or chloroform—and possible toxic effects of dressing, as, for example, iodoform. Some years ago I saw in Massachusetts a woman of unstable mental equilibrium, who became insane after the administration of gas for extraction of teeth, and who remained insane for eight or nine months. (6) The mental distress or anxiety prior to and the shock of the operation are factors. I once saw an obstetric case in which, just as the head was emerging, the patient became delirious. A curious group of cases showing a probable family psychosis came under my notice, illustrating the force of mental shock in susceptible cases. The wife of a railway flagman was brought to the hospital wildly maniacal from the shock of seeing an accident. Within a week her married daughter, who had taken care of her for the first twenty-four hours at home, was brought to the hospital in a similar condition. Within ten days a younger daughter was brought in profoundly depressed with suicidal mania. The mother recovered, the older daughter died, and the second daughter has now what we call dementia præcox. The element of heredity was quite probably present here, but the family history could not be obtained.

One of my friends connected with Johns Hopkins Hospital tells me that the order in which they have observed postoperative mental disturbances is: (1) In alcoholics; (2) in the occasional instances of infection, toxic, renal, or otherwise; (3) and probably included in the second group, psychoses following operations upon the thyroid gland.

I would urge upon the surgeons who see these cases long before the psychiatrists to dwell with considerable thought upon one of the most valuable papers upon this subject to which I have listened —that from Dr. Mumford.

I have histories of three or four cases, which my time will permit me only to summarize; the first, one of Dr. Kelly's cases, in which the patient did very well for four or five days, then suddenly became maniacal, recovered from the psychosis, and died two and a half years afterward from the trouble which caused the first operation.

The second case was one of those instances of acquired mental instability in a young woman with a good family history. She was operated upon for general tuberculosis of the peritoneal cavity, from which she entirely recovered, but within a week of operation she became depressed and has had, after recovering from the first attack, several recurrent attacks.

The third case is a typical one of infection from a badly treated ischiorectal abscess.

DISCUSSION ON POSTOPERATIVE PSYCHOSES

Dr. Howard A. Kelly, Baltimore, Md.: It well behooves the surgeon to pay close attention to postoperative psychoses, as of all the surgical sequelæ, hardly even excluding the much-dreaded pulmonary embolism which falls like a bolt from the azure, none are so dreadful, and if the psychic condition becomes fixed, death itself is far preferable.

Is it not a little curious that after a lifelong training in things medical, and constant contact with psychiatrists, one may yet feel unable to employ even their current terms with accuracy, but such is the fact. I know of no greater difficulty than that of understanding and defining in precise terms the vagaries of the psyche, that indefinable, intangible tenant of the body, that "Animula, vagula, blandula, Hospes, comesque corporis."

Let me premise by saying that I deal in my discussion with pronounced cases alone, and that in every instance in my own practice I have sought and acted under the advice of a trained psychiatrist.

The classification used is that employed by Picqué, of Paris, writing five years ago. Being referred to Kraepelin for late information, I was told that his last edition was in 1889. I have used the following nomenclature:

Melancholia.
Paranoia.
Acute confusional insanity.
Acute mania.
Dementia præcox.

The physical basis of these disorders (except perhaps the last) is not known, I believe. It seems clear that psychic causes may lead to profound psychic disturbances, and that in some instances, at least, the grossly abnormal may speedily become normal again, apparently warranting the inference that in the initial stages the brain lesions may not be of a profound nature, but such as may be sometimes easily wiped out, as, for example (for the sake of securing a mental picture), when one eliminates a toxin by free purgation. There are two groups of cases which must be carefully distinguished etiologically from the essentially practical standpoint of the surgeon, namely:

(*a*) Those in which there is an infection or demonstrable source of toxemia.

(*b*) Those in which the psychosis is all that can be found ailing the patient.

The first group includes the occasional profound cases of sepsis, or those in which some focus of necrosis exists, usually manifested by high ranges of temperature, associated with a more or less marked local reaction. I am struck with the fact, in reading the histories of the earliest reported cases, that a profound sepsis must have been the cause of a toxemia psychosis in a large percentage. I do not believe that modern surgery has to reckon often with this factor; if this is true, then these mental sequelæ are relatively fewer in number to-day than a generation ago.

Furthermore, and most important, a latent Bright's disease quickened into activity may sometimes be responsible for a profound mental disturbance. These two causative factors, especially the last, which might readily escape notice, must ever be borne in mind.

A marked predisposition is not a common factor, I think (although Baldy's analysis of 15 cases showed 11 predisposed). In a long series, however, it appears often enough to show the extreme importance of ever bearing it in mind.

Every surgeon, with a large practice, now and then operates upon a patient who has at some time been confined in an asylum or who has shown extraordinary mental peculiarities, giving his or her family cause for anxiety. Here manifestly the psyche is more readily disturbed, and one watches the outcome of an operation with greater solicitude.

Again, a patient with a growing mental disturbance is known to have some surgical affection—a tumor, for example, or a hernia; the distraught family naturally fixes on this as a probable cause and seeks the advice of the surgeon. I have had two such men under my care within the past year. These are hardly the class of cases we are studying.

I saw a sad case recently with Dr. Brush, a patient of Dr. Corcoran, of New Orleans; a fine, handsome young woman, who had an idea that certain parties were following her with evil motives and talking about her, and was suffering with a cyclic insanity. She had a pelvis choked with a large fibroid tumor, with associated inflammatory products. Dr. Brush agreed that she was

entitled to relief from her distressing local condition, but did not hold out much hope on the mental side. A most difficult operation was done; she recovered surgically and made, as well, a speedy, brilliant recovery mentally, becoming normal, bright, sweet, and responsive; this lasted for some weeks, when she relapsed, as before, and is now, I believe, hopelessly, violently insane.

The postoperative psychosis, whatever its remoter cause, is, I believe, directly due to the mental shock of the operation *per se*, and not necessarily to any particular kind of an operation; the duration and the severity of the procedure are minor factors. It is due rather to the attitude of intense expectancy, even of dread, inspired by a new and unmeasured powerful force with which the patient feels she has to cope, while casting about in vain for adequate mental resources with which to meet it.

The regular routine of life is suddenly interrupted, the patient becomes the centre of an anxious, solicitous interest in the home, the focus of many pairs of eyes, and, it may be, of furtive whispered conversation. She enters a hospital which she may long have held in secret dread; the institutional sights and sounds may serve to aggravate her apprehensions. Finally, as a climax, she passes into a temporary oblivion for the first time in her life, under dramatic conditions, uncertain whether she will live to come out of the artificial sleep. The mind, thus brought up against a series of startling facts, through which it is incompetent, by lack of experience to guide itself, recoils and collapses under the prolonged tension.

Treatment. If I am right in my conclusions relative to the cause of permanent postoperative psychie disturbances, then it is obvious that much can be done to prevent them.

First, it is important to recognize morbid psychic tendencies beforehand, and to give such patients more than usual personal attention in preparing them for operation, doing everything possible to avoid shock or upsetting of the nerves.

It is important for the benefit of this entire group that the physician should know his patient well enough to secure her confidence, affection, and hearty coöperation, so that she will come to feel that she has a strong arm to lean upon, more than sufficient to make up for her own weakness and inability to cope with the unusual situation she is called upon to face. The doctor must become a moral prop upon which she can depend, so that she does not have the feeling that she is going down alone and unsupported into an abyss from which she may never emerge.

Many patients show this profound sense of need of aid, and pathetically appeal for support when in taking the anesthetic they insist upon holding the hand of the physician or of a nurse until they lose consciousness. I would insist with the utmost emphasis I can command that levity, light talking, and laughing should be banished from the anesthetic room; at the same time let

there be no undue seriousness, solemn faces, or lacrymose farewells. It is best for the morale of the patient not to anesthetize in the operating room, but rather in a pleasant chamber like a bedroom with natural surroundings.

I was impressed in Dr. Crile's clinic in Cleveland by the perfect quiet, upon which he insisted, and the fact that he provided a sort of moral anesthetist, in the person of a pleasing, kindly woman, who held the patient's hand and talked quietly to her until she dropped to sleep under the anesthetic. Dr. Crile has the same person attend the patient as she recovers consciousness, so that the operating interval between is obliterated as far as possible.

Dr. A. H. Ferguson, of Chicago, has an interesting way of treating his exophthalmic cases (that troublesome case) by "sneaking" them through the operation without their knowing it. He does this by giving enough chloretone in small doses for several days beforehand to slightly benumb the higher faculties. Then, as an apparent part of the treatment, the patient is familiarized with the anesthesia cone, by having it put over the face daily with some cologne upon it. When the operating day comes, chloroform is gradually substituted until the patient drops to sleep, when she is operated upon and back in her bed without ever realizing that anything surgical has ever been done.

After the operation our patients ought not to be given large doses of sedatives; at the same time we must not go to the other extreme and allow them to suffer extreme pain.

The conditions surrounding the patient after operation ought to be as natural as possible, stimulating and refreshing, and her thoughts ought to be diverted from herself and her own condition, by assuming that everything is proceeding in a natural, normal way. I make a great deal in my own work of getting the patient promptly out of the house, say within two or three days, into the open air and sunlight on a large porch. I believe that these principles, variously modified, are useful in all cases, and by lessening the disagreeable and distressing *entourage*, will preclude a number of disastrous psychoses.

Conclusions. 1. That postoperative psychosis is due to the mental shock of the operation.

2. That in predisposed individuals any type of postoperative psychoses may develop.

3. That many cases, even of the most aggravated types, may be called "functional" (with apologies for using the term) and will in time recover.

4 That the treatment is, first of all, prophylactic in distinguishing the predisposed.

5. That the utmost care should be given to minimizing the horrors of an operation by making the patient feel that she has a friend in her surgeon on whom she can rely, and by making the surroundings of an operation as agreeable as possible.

Dr. Edward Martin: I may preface my remarks by saying that I shall not take my allowed ten minutes because I have had a strikingly clear example set before me as to the power of covering the entire subject by four words. Every surgeon in the room feels that when Dr. Mitchell said the "surgeon pulled the trigger," he has practically covered the subject. We do not recognize that a perfectly healthy individual, in good physical and mental health, can be made insane by any form of surgical intervention practised at the present day. We recognize certain postoperative mental disturbances as rather common. I hesitate to distinguish them by any more specific title after the criticism that Dr. Da Costa received from Dr. Brush. We see a type of depression which we call "hospitalism." For days the patient will lie apathetic, and is cured by being sent out of the hospital. We see a type of homesickness—the person weeping easily, highly emotional, and longing for his usual surroundings; again, cure is accomplished by sending the patient home. We very rarely see the instances of true insanity, and in talking with the various surgeons of the larger hospitals and with the gynecologists I find that the experience of each individual is so slight that generalization is impossible. Each man will remember one or two cases, always, as Dr. Brush has said, with preceding psychic history, the condition coming on simply because "the gun was loaded," the operation serving simply as a trigger pull.

In regard to the type of patients who will exhibit postoperative psychoses, again generalization seems absolutely impossible. The hysterical, weeping, fearful woman, with a settled conviction that her operation will prove fatal, makes a prompt recovery. The calm intellectual type is just as likely to exhibit the slight degrees of transitory postoperation phychoses as is the hysterical type.

Dr. Mumford speaks of the after-effects occasionally seen in which the patient is depressed by the thought of the loss of organs. As a rule, with us an operation, even a mutilating one, is regarded by the patient as a thrilling experience, and an apt and perennially fresh subject for postprandial conversation.

Dr. F. X. Dercum: The most important matter in the study of an insanity following the administration of an anesthetic or of an insanity consequent upon an operation, is to determine the actual facts as to the cause. This, on account of the complexity of the problem, is often a matter of difficulty. However, one factor presents itself as of overwhelming importance and that is the factor of a neuropathic constitution, hereditary or acquired. Upon this point Picqué and Briand, Pilcz, Hammond, and other writers have especially insisted. Indeed, there can be no doubt that every now and then the insanity really precedes the operation, perhaps in a larvated form; and in other cases bears to the operation only the relation of sequence. However, in the larger number of cases the relation of this sequence must, in part at least, be translated as causal.

The mental disturbances following operations are of two kinds: (1) Those comprised under states of delirium, confusion, and stupor, and (2) those presenting the symptoms of the manic-depressive or of the paranoid forms. The distinction between these two groups is both from the standpoint of prognosis and of treatment of the utmost importance.

The affections of the first group are due either to the anesthetic or to one of the following causes attendant or consequent upon the operation: (1) Shock with its accompanying exhaustion, factors both of which are the more potent the more the patient has been already exhausted by illness previous to the operation; (2) hemorrhage; (3) the absorption of drugs used in dressings, *e. g.*, iodoform; (4) sepsis. The form assumed by the mental disorder from these causes is always delirium, confusion, or stupor—not infrequently it is delirium, quite commonly it is confusion, more rarely it is stupor. The forms of this group are further distinguished by the fact that they make their appearance within a few days after the operation—two, three, or more days—and finally by the fact that the prognosis is, other things equal, very favorable. The greater number are of short duration, can be properly cared for in the hospital or in their own homes, and rarely require commitment to the asylums. The deliria are always short of duration, the states of confusion or stuporous states are more persistent, but even the latter, unless very prolonged, do not justify asylum commitments; especially is this the case when the patients still require surgical care.

Into the causation of the mental disorders of the manic depressive, and of the paranoid groups, the element of neuropathy enters to such an extent as to be the dominant, and in many cases, indeed, the sole factor. The manic depressive group is most frequently but not always represented in the form of a melancholia—a melancholia which has its inception weeks and sometimes months after the operation. Its symptoms are the same as in melancholia arising under other circumstances, and it is quite frequently of such severity as to necessitate asylum commitment. In cases in which the mental disorder assumes a paranoid form, the symptoms likewise come on late, the patient manifests systematized delusions, usually persecutory in type and persistent in character, and quite commonly the patient is in such a condition as likewise to necessitate asylum commitment.

The necessity of the prompt differentiation between the delirium, confusion, and stupor group on the one hand, and the manic-depressive and paranoid groups on the other, is, of course, apparent and urgent. An important qualification, however, remains to be made. When we consider that, in proportion to the vast number of operations constantly being performed, postoperative mental disorders are not numerous, and that this fact of exceptional occurrence is true even of the deliria of intoxication and infection, we have the right to infer that when the mental disorder is prolonged, the patient always

suffers from an underlying neuropathy. It is exceedingly probable that in at least 50 per cent. in which postoperative disorders belonging to the group of delirium, confusion, and stupor occur, the intoxication has been added to, and is acting upon, a nervous system, already feeble in resistance.

That mental disorders following operations may bear no relation to the administration of an anesthetic is proved by the fact that Dupuytren wrote as early as 1819 upon nervous delirium following operations.

I have but little personal experience in the mental disorders following solely the administration of anesthetics, and I believe such disorders to be very rare. Many years ago the postanesthetic insanities were studied by Savage, who came to the conclusion that they are of rare occurrence and are met with only in certain predisposed subjects; that the patients are unstable from heredity or from physical causes, such as alcoholism, nervous exhaustion, and the like. He had met with cases following the use of chloroform, ether, and nitrous oxide. The symptoms had arisen immediately after the use of the anesthetic. The patients being physically weak had passed at once from the unconsciousness of anesthesia into states of excitement or stupor. The character of the delirium is occasionally such as to have suggested to my mind that the anesthetic has stimulated the thyroid gland, and especially when a rather prolonged and intense delirium follows an ordinary ether or chloroform administration that we really have a thyroid delirium to deal with.

Other and persistent forms of mental disorder may arise from anesthesia; often these are bizarre and curious—usually in proportion to the neuropathy present. Thus, in a case recently studied by me, a young man, aged twenty-three years, had two years before had a tooth extracted under nitrous oxide gas. He had felt somewhat shocked after the operation, but notwithstanding had returned to his place of employment. Later in the day he was sent home by his employer. Apparently he was himself on the day following and for some weeks thereafter, when he began to suffer from peculiar spells, as he explained it. At the time that he took the anesthetic and as he was becoming unconscious, he saw himself, his mind and his body—as something apart from himself; and this continued until he became completely unconscious. Weeks later he began spontaneously to pass into a condition similar to that in which he was while taking the nitrous oxide and before he became unconscious. The sense of being double, of being someone other than himself, of seeing his mind and body separated from himself, would come over him and persist for several minutes without, however, passing into unconsciousness. Gradually the seizures have become more frequent, so that at present they occur many times a day and have begun to interfere with his duties as a clerk. Gradually, too, the seizures have become better defined and the sense of separation of himself from his mind and body more pronounced. The stigmata and other evidences of hysteria were absent. An investigation promptly revealed a

family history presenting neuropathic features, and the patient himself presented earmarks, both physical and mental, suggestive of an underlying neuropathy. The only thing, however, that was definitely apparent was the curious cleavage of the personality which he described. It would, obviously, be absurd to attribute this lesion of the personality to the nitrous oxide; indeed, this lesion can only be explained by an intrinsic proneness to disease; yet given the preëxisting neuropathy, the nitrous oxide must be regarded as the exciting cause.

The mental disorders following operations may occur, as has been pointed out this evening, after operations of all kinds; they are met with, with special frequency, after abdominal and ophthalmic operations; sometimes they are to be attributed to the loss of certain internal secretions consequent upon the removal of the sexual glands, sometimes to the fact that the patient realizes the gravity of the mutilation; quite commonly is this the case in castration of the male—long persistent mental depression following. Occasionally the operation is exceedingly trivial, as witness the case reported by Picqué, in which insanity followed a mere circumcision.

The great role which neuropathy plays in the production of postoperative insanities should, of course, discourage operations in neuropathic subjects. This fact, it seems to me, is of the very greatest importance. First, we have to deal with the unreasonable fear which operation often inspires in such subjects; not infrequently the psychosis following the operation is directly traceable to this fear. On the other hand, when the neuropathy exists in the form of a hysteria, a most unfortunate result not infrequently follows, namely, the induction of a desire for repeated operations, which rises to the level of a veritable psychosis. Every surgeon has met with such cases and every neurologist can cite them by heart. Often the facts are almost incredible. I recall the wife of a physician who some years ago was under my care in whom first the ovaries were removed, then the appendix, finally the uterus, and lastly, not content with what had been accomplished, the patient insisted upon the amputation of the labia minora. She now attributed all of her troubles to these structures, declared that they were "dog-eared," and that she would not be well until they, too, were removed; and, strange to say, this incredible mutilation was also practised. At the time she reached my hands the rectum had become the seat of her troubles. An examination of the rectum by Dr. Keen, it is needless to say, revealed the rectum to be entirely healthy and, save for an area of hysterical hyperesthesia, an hysterical stigma—no symptom could be detected. Operation being refused, she left my care dissatisfied and unhappy, and, I believe, incurable. Another patient had had at various times ovaries, appendix, and uterus removed; at another, the coccyx; and at a still later operation a portion of the sacrum. Still unhappy, still desirous of operations, she reached my hands; a condition of anorexia nervosa, so

grave as to be almost fatal had supervened, and a partial restoration to health was accomplished only after years of patient care. A third case, in whom, in addition to removal of all removable structures from the pelvis, both kidneys had been sewed fast, presented herself some time after for treatment, saying that she knew why she felt so badly; it was because her kidneys had become loose again, and she again asked to be operated upon. I could add other cases to this list should time permit; one, perhaps, I may be pardoned for because of its extraordinary character. This woman had, strange to say, never had gynecological operations, but she had accumulated twenty-three sets of eyeglasses, from as many different oculists; thirteen sets of false teeth, from as many dentists; had had her stomach scrubbed out by Türck, of Chicago, and had been subjected to innumerable forms of diet, movement, and other cures; and, when she finally reached my hands, her condition was such that her commitment to an asylum was the only measure left. Perhaps it is not fair to speak of this in a discussion of the postoperative psychoses, but it is, notwithstanding, of value in illustrating the hysterical craving of some patients for constant interference.

In conclusion, I would say that neuropathic patients, and especially hysterical patients, should never be operated upon save under the stress of a grave necessity. Senile cases, also because of their diminished resistance, should, whenever possible, be spared the knife; here because of the senescence of the tissues, particularly the arteriosclerosis, the resistance of the patient is greatly diminished, and, as experience shows, mental disturbances not infrequently occur. Similar remarks apply to cases of contracted kidney, to alcoholics, and to other subjects of chronic drug or other poisoning.

Dr. Chas. K. Mills: In listening to the papers and discussion, my mind has reverted to the infrequency of mental disorders after operations on the skull and brain. We have heard much of such disorders from operations on other parts of the body; I have had an experience with cases, reaching into the hundreds, of serious cranial operations, and I can recall only three or four in which insanity has followed these operations. Instances of insanity after serious operations upon the spinal cord have also been few in number. I recall one case operated by Dr. Frazier in which, following laminectomy and the opening of a circumscribed serous cyst, the patient, in the course of a week or two, became insane temporarily, suffering from a form of confusional insanity, probably toxic in origin. My experience is that the insanities after operations on women occur in women of a certain temperament and predisposition. The term psychasthenia applies more aptly to these patients than the term neurasthenia. These psychasthenics sometimes develop somewhat serious forms of insanity. The other instances of insanity are dependent upon the pain, exhaustion, and distress of the disease preceding the operation, or are due to toxemias which follow operation.

Dr. S. Weir Mitchell: I have not been disappointed in my expectation that I should learn something tonight. I have learned a great deal. Two or three points not covered might be mentioned: What is going to be the result of the use of local anesthesia which has become so fashionable in some circles? I hear of abdominal operations done under local anesthesia. I think to have the interior of one's abdomen exposed to one's own view would tend as much as possible to produce some of the insanities of which we have been speaking. It is a fact that occasionally insanities have been cured by grave operations. One such case was an amputation. Another was an attempt on a man's part to cut his throat. The man bled almost to the point of death, but his life was saved and he recovered from his insanity. I don't recommend the method. We have the very interesting work of Dr. Crile, but it does not seem to me that it explains the sudden and acute cases of shock. The greatest of surgeons known to me and the one that has done the largest number of operations known to us is the surgeon called "War." I have seen cases in which sudden delirium or sudden delusion followed instantly upon a gunshot wound. Most of these cases it is needless to speak of at length, because I have related them in my book upon gunshot lesions of nerves. Two or three were most remarkable. One case was that of a colonel who, after being shot, cried to his men to run, that the Rebels were on them. He fell on his face, was delirious for sometime, but after amputation of his arm returned to the regiment and to duty that evening.

Another case was that of an officer in the Mexican War, a man well known for courage. A ball struck his heel; he limped up and down the line calling to the men to run, that everbody was going to die, and for hours was in a condition of the wildest maniacal excitement. This passed away entirely within forty-eight hours. He asked for a court of inquiry, which, of course, was denied a man of well-known courage.

This is all I have to say, except to thank our friends who have come here to tell us so much.

Dr. John K. Mitchell: There is not and there cannot well be any reliable evidence as to the frequency with which neurasthenia or other forms of mental disturbance follow operations, since the operating surgeon often knows nothing of their occurrence, many of them not making their appearance until weeks or even months after surgical and anatomical recovery is complete. The surgeon's records therefore show only such acute troubles as passing deliria, temporary confusion or aberration, such as sometimes show themselves directly after operation, and may with probability be referred rather to the anesthetic or to the physical shock than to the operative procedure; some examples of this type are recorded in the accompanying list.

For the purposes of the present discussion I have made an examination of some hundreds of case histories, taken with few exceptions during eight or

ten years past. The investigation was limited to this period for several reasons: First, because during this time special attention had been given in my case-taking to those instances in which operation was alleged as among the causes of the nervous trouble; second, because many of the cases within this time are near enough for memory to confirm or criticise the formal notes; and third, because the histories are much more minute and complete than those of earlier years.

To make clear the basis of the diagnosis, a brief explanation of terms must be made. "Neurasthenia" covers cases of the fatigue-neurosis type, without marked mental symptoms. "Melancholia" is used to indicate instances of nervous depression, often hypochondriac, not including the more serious forms, such as might be put under the head of manic-depressive insanity, or the recurrent periodic melancholias. "Psychasthenia" has been applied only to cases with obsessions or *idées fixes*, and those which, though superficially seeming neurasthenic, exhibited on further study mental disturbances. These are all the "revised diagnoses" recorded when patients were discharged, the original titles having been hysteria, hysteroneurasthenia, hypochondriasis, neurasthenia, cerebrasthenia, myelasthenia, or whatever other diagnostic fragments one might choose to chop the general name of neurasthenia into, intended in practice to serve as temporary sign-posts pointing to the therapeusis. So far as possible, instances in which distinct neurasthenia was present before operation have been excluded, so that the form in which the record stands fairly represents careful final diagnostic consideration of various mental, psychical, or neurotic disorders consequent upon, if not causally connected with, surgical procedures. Further, only notes of private patients have been used, not even including those treated in private rooms in hospital service, the former being for the most part under closer observation by myself and by experienced assistants, and their histories not depending in any way upon records made by internes, who however alert and well trained have not the same opportunities of personal study of the patients.

Certain definite forms of neurasthenia and psychasthenia have been omitted from consideration altogether, such as those of sexual origin, a few in which it seemed possible that beginning paresis or dementia præcox was at the root of the symptoms; several in which the history was too vague, and those in which the patient for any reason was not long enough under observation for the certain establishing of the diagnosis.

Three hundred and forty-four case histories remained after these exclusions, ranged under the several headings named. These were reviewed with the aim of discovering how many of them could fairly and reasonably be classed as postoperative or postanesthetic troubles.

Total cases examined, 344. Women, 220 (64 per cent.); men, 124 (36 per cent.).

No.	Social condition.	Age.	Year operated.	Operation.	Remarks.
1	Female, married	30	1887	Cervix dilatations	Prof. Goodell. Panic terror preceding operation; violent hysteria following, lasting many years.
2	Female, married	34	1889	Ovariotomy, double	Prof. Goodell. Mania immediately following operation; death from exhaustion.
3	Female, single	38	1893	Ovariotomy, double	Neurasthenia following, many years' duration.
4	Female, married	36	1899	Ovariotomy	Nervousness preeeded; ovariotomy; stump-abscess complication.
5	Female, single	62	1900	Caruncle and hemorrhoids	Melancholia followed.
6	Female, married	43	1900	Kidney fixation; curettage (2 operations 1 year apart)	Hysterical hypochondriasis.
7	Female, single	28	1901	Ovariotomy	Hysteria.
8	Female, married	31	1903	Cervix repair	Neurasthenia, hypochondriac type.
9	Female, married	36	1903	Total hysterectomy	Mother had puerperal insanity; psychasthenia; obsession of guilt.
10	Female, married	55	1898	Hysterectomy; amputation of breast (2 operations 5 years apart)	6 months after first operation nervous depression began, lasting 5 years; then breast amputation followed by increased depression.
11	Female, single	28	1903	Appendectomy	Bad family history of insanity; acute depression.
12	Female, married	32	1896	Perineum repair, 1896; ovariotomy, 1897; hysterectomy, 1902 (3 operations years apart)	Previous health perfect; neurasthenia.
13	Male, married	30	1904	Appendectomy	Acute insanity of a few weeks' duration.
14	Female, married	..	1905	Total hysterectomy	Psychasthenia.
15	Female, married	36	1899	2 operations: one ovariotomy, then hysterectomy and ovariotomy	Doubtless history of nervousness preceding; hysteria following.
16	Female, married	44	1905	Cervix repairs	No ether given, at patient's desire; hypochondriae neurasthenia following directly.
17	Female, married	30	1906	Sebaceous eyst: cervix, kidney fixation	Always nervous, much increased after operation and finally severe psychasthenia.
18	Female, married	46	1906	Curettage (also 2 induced abortions)	The abortions added a moral cause; operations perhaps only contributed to the sequent neurasthenia.
19	Female, married	38	1899	Curettage; ovariotomy; suspension (3 operations)	Neurasthenia; previous health perfect.
20	Male, married	33	1907	Appendectomy, 1903; epulid, 1907	Psychasthenia followed first operation, increased by second.
21	Female, married	26	1908	Ovariotomy; nasal septum straightened	Neurasthenia; previous health good; gastroptosis.
22	Female, married	57	1908	Hysterectomy for tumor	Neurasthenia.
23	Female, single	50	1908	Ovariotomy; several ocular tenotomies	Hysteroneurasthenia.
24	Female, married	..	1909	Ocular tenotomy; 2 curettings	Increasing neurasthenia.
25	Female, married	..	1909	Cervix repair; curettage	Sudden neurasthenia, with depression, six weeks later.
26	Female, single	44	1902	Hysteroövariotomy	Previous health perfect; hypochondriac neurasthenia of very obstinate type; endless doctors; psychotherapy, etc.
27	Female, married	28	1909	Appendectomy; hemorrhoids	Neurasthenia; operation during typhoid attack.
28	Female, married	38	1910	Appendectomy	Psychasthenia, hypochondriac ideas.
29	Female, single	40	1910	Appendectomy; 2 operations on hemorrhoids	Always nervous but never neurasthenic before operation.
30	Female, married	20	1910	Appendectomy; acute, first attack	Neurasthenia.
31	Female, married	26	....	Ether, no operation	Delusion of criminal assault.

The dates refer usually to the year in which operation was done, but with few exceptions the *histories* of the cases belong to the years from 1898 to 1910.

Instances of neurasthenic or mental disorders following operation or anesthesia make 31, or 9 per cent. of the total cases examined. Women, 29, or 94 per cent. of the postoperative cases; men, 2, or 6 per cent. of the postoperative cases. Of these 31, 29 are from full case histories, selected by the process of elimination described, as fairly representing instances of postoperative trouble. With these 29 are included 1 case of my own of which I find no complete statement in my archives but of which memory supplies a very distinct record, and 1 supplied by Dr. Weir Mitchell, respectively Cases 2 and 31.

The operations in these cases varied very widely—from the most trifling surgical intervention, such as ocular tenotomy, straightening of the nasal septum, or dilatation of the cervix uteri, up to total hysterectomy and ovariotomy.

The sex distribution is rather striking. Although aware that the proportion of male patients with serious neurotic symptoms was a large one, it was rather unexpected to find it more than one-third of the total. It is interesting to observe that this close equality in the incidence of neuroses is not maintained in the cases suffering from postoperative disorder, in which males have a very small share. The comment, of course, suggests itself that diseases of the female reproductive organs account for a large number of the operative cases. The males represent but 2 in the total of the 31 instances of postoperative mental disturbances, and these 2, therefore, amount to less than ½ of 1 per cent. of all the cases examined. While not directly connected with the subject, it is worth adding that in the total case histories examined in making up this list the proportion of male cases gave 41 per cent. of the neurasthenias, 25 per cent. of the melancholias, and 41 per cent. of the psychasthenias, although from this number all instances of sexual neurasthenias and obsessions were strictly excluded.

The worst and most persistent instances of nervous disorder have not by any means always followed the most serious operations. No doubt, as in other neurasthenic conditions, a certain constitutional or temperamental predisposition is required as a precedent, and one cannot make a rule excluding this as one of the causes, as one would in judging of purely traumatic neuroses, but I have tried to exclude from the list those in which there were marked and distinct causes other than operative in addition to the neurasthenic predisposition. Bodily shock or severe pain are not evidently among the necessary causes of this condition. The mental or nervous factors, particularly fright, play a larger part than is generally attributed to them, I feel sure. We practitioners are so accustomed to operations that we do not always allow for the alarm of patients, and treat their fears too lightly.

Complications in the surgical course of the cases seem to have played no part, as in only one instance (No. 4) was any such trouble reported, and in many it was particularly stated that progress had been uninterrupted. Nor

can reckless or careless surgery be charged with the unfortunate results, for if it were possible to publish the operators, many distinguished names would be found in the list, whose positions would sufficiently guarantee that care had been used and every precaution taken, both in the selection and treatment of the cases.

Two or three of the cases collected are sufficiently interesting for brief separate comments, as they teach highly instructive lessons.

In one, No. 31, a young woman, a widow, went to a dentist's office with her mother and her attending physician, with the intention of having two teeth extracted under ether. When the administration was begun she struggled and fought so wildly that her mother would not consent that the attempt at anesthetization should be continued. The administration ceased before complete relaxation was produced, and no operation of any kind was performed. When the young woman came out of her ether intoxication, she asserted with every evidence of the fullest belief that she had been assaulted during her stupor, and this delusion, in spite of every assurance of her mother and of the physician, who had never left her side, persisted very strongly for several weeks and then gradually faded.

No. 1, seen many years ago with the late Professor Goodell, was etherized for dilatation of the cervix. She was an intelligent woman of education and had the matter fully explained to her, but was in great fear of the anesthetic. The operation was done briefly, with no violence. When she recovered from the anesthetic she was in a condition of extraordinarily severe hysteria, and continued for twenty years to exhibit, one after another, an amazing series of hysterical phenomena; and, indeed, up to the time of her death never recovered complete mental balance and control.

In another case, No. 2, operated upon by Professor Goodell, a difficult ovariotomy, with adhesions, requiring rather long etherization, the patient, who had been in a perfectly good mental state before the operation, was wildly maniacal after the ether and continued in a state of furious mania until her death from exhaustion, about two weeks later.

No special investigation was made in the earlier instances as to the actual time spent in bed after operation—but in the later ones this question has been systematically inquired into, and has usually been answered by the statement that the patient was up at the earliest possible time. I am not unaware that there are good surgical reasons for getting patients out of bed, particularly after abdominal operations, as soon as may be, but I am strongly of opinion that troubles of the kind we are discussing would be less frequent if, instead of trying to get the patient up as soon as possible, the period of rest in bed and mental repose, of course with general treatment, massage, and perhaps bed gymnastics, were rather to be extended than curtailed—an opinion borne out by personal experience gained in watching the numerous instances in which

it has been necessary to have operations performed upon patients either already neurasthenic or at least with the temperamental tendency toward nervous disorders. Under these circumstances, it has been my custom to insist upon a more prolonged rest and isolation than would be considered necessary for purely surgical reasons, and with excellent results in avoiding postoperative nervous complications.

The statements of patients as to physician's opinions we all know must be received with the utmost skepticism, so that we may to some extent discount the assertions quite frequently made that relief from neurasthenic symptoms had been held out as a reason for operating; but in many instances there has been additional testimony confirmatory of the patient's reports, in some coming from the surgeons themselves on this point. It has already been said that cases in which neurasthenia was clearly present before the operations are omitted from the list presented. Were they included the number reported would be much larger.

This leads to a warning, which may be addressed both to the physician, who, desperate over the lack of success of his treatment of a neurasthenic woman, turns for aid to his surgical colleague—and also to that invaluable coadjutor. Should the question of surgical treatment of a neurasthenic person arise, much more than the ordinary care must be exercised in deciding upon operation. Wise practice will choose any other route than a surgical one, however roundabout may be the journey. The only sufficient reason for an operation in a neurasthenic is that the procedure is one which would be absolutely demanded were the patient in perfect nervous health. The physician and the consulting surgeon must never be deceived into undertaking an operation for the relief of neurasthenic symptoms, unless these symptoms would require, imperatively require, surgical measures in a person not nervous. An operation may relieve neurasthenic symptoms; it will not cure the patient and there is a good chance that a few months will see her worse than ever, having gained nothing but a new experience and very likely an exchange of old symptoms for new ones. We should think twice before advising an operation on a neurasthenic, and having thought twice, it will often prove best to think a third time and then not operate. Above all, the operation should never be recommended with the idea, or even the hope, that if successful it will cure the neurasthenic. The neurasthenia may be no worse after than before, or it may be worse—but most assuredly it will very, very seldom be cured.

Dr. Mumford: To decry surgical operations is very far from the spirit or purpose of anything I have said now or previously. I think a few lines that I wrote two or three years ago will answer any such intimation as that:

"If I were to leave the matter here, however, I should be giving a grossly false and pessimistic impression of the advantage of surgical operations from

the patient's point of view. Nearly all of my correspondents—the most pronounced psychic wrecks even—assert that they are glad the operation was done. The persons with anatomical failures are those who regret the operation. The persons with psychic failures are feebly complacent because, as they say constantly, their physician has told them that the choice lay between operation and death or a worse invalidism."

Dr. Brush (closing): I have nothing further to add, except to thank the College for its courtesy.

DEHYDRATION BY DIETETIC MEASURES[1]

AN INTERPRETATION OF THE KARELL, OERTEL, AND WIDAL TREATMENTS OF CIRCULATORY AND RENAL DISEASES

By A. MAGNUS-LEVY, M.D.
BERLIN

The German word *Schönungstherapie* being untranslatable, I have adopted as the nearest English equivalent for it the expression "protective therapy" or "sparing therapy." This means to allow an organ to rest and to strengthen it by temporarily making as little claim on its functions as possible. In contrast to *Schönungstherapie* or "protective therapie" is *Uebungstherapie,* a treatment by which an organ is stimulated to work. These are the ideas and terms first employed by the German physician Albin Hoffmann. What they mean will be readily appreciated when the different forms of therapeutics employed in the treatment of the diseases of the heart are considered. Confining an arteriosclerotic patient to his bed is *Schönungstherapie*—protective treatment. If, on the other hand, walking and climbing are prescribed for him, which, of course, must be definitely limited, that would be employing the *Uebungstherapie*—treatment by exercise. Hoffmann has most wisely discussed the problems of general therapeutics from these two standpoints—the treatment which protects and spares an organ, and the treatment by which an organ is stimulated to work or perform its functions. Indeed, these two ideas are applicable to the therapeutics of the impaired functions of all organs.

The dietetic treatment of circulatory disorders is essentially one

[1] Read at a special meeting, May 13, 1910.

form of protective therapy. The names of three authors demand special attention in this connection—those of Karell, Oertel, and Widal. The best and most widely employed methods of treatment are associated with their names, and these also indicate distinct epochs in the development of therapeutics. There are wide differences in the practical standpoints and underlying theoretical considerations adopted by these authors. The essential feature of the Karell treatment is the exclusive use of milk in relatively small quantities at definitely stated intervals. The idea underlying Oertel's method is a great reduction in the quantity of fluid ingested. The Widal treatment, on the other hand, consists in excluding sodium chloride as much as possible from the food, which in other respects is the ordinary mixed diet.

Karell was purely an empiricist; he described his procedure as a milk treatment, *la cure de lait*, and stipulated that its rigid enforcement required six weeks. He began in the first week by giving small quantities of milk, from 60 to 200 c.c., four times a day at intervals of four hours. He then increased these quantities in the course of the second and third week, and finally allowed at the end of the fourth week the addition of small quantities of foods intended to stimulate the appetite, such as salt herring and salt bread, but without any other concessions. Only after the lapse of five or six weeks did he allow the patient daily a single real meal, besides which, three times a day, milk in various forms was to be taken. Karell considered that the chief field for his method lay in the treatment of all sorts of circulatory and renal disorders, especially when combined with edema. But he obtained good results in other conditions as well; for example, in the most varied diseases of the gastro-intestinal tract, in neuralgias, and in functional nervous affections. Karell was an excellent practitioner and paid but little attention to theories. He even deprecated any such attitude on his own part, and simply said he believed that the results obtained were referable to one of the components of the milk or to the particularly suitable combination of all its components. It did not occur to him that it was chiefly negative qualities that produced the results; that is, the reduction in the total amount of solids and fluids given,

and that the treatment was really an especially marked form of protective treatment.

Oertel started out from a theoretical basis. He assumed, with a certain amount of justice, that after the development of a circulatory disorder it was chiefly the increased amount of fluid in the body that made a return to normal conditions difficult. He regarded the daily ingestion of large amounts of fluid as contributing greatly to the work imposed on the heart, and endeavored to correct this factor. The field of his activity explains why he came to devote special attention to the amount of fluid taken in, for Munich, the city in which he worked, is the city in which the consumption of beer is greatest. He began his investigations and his treatment by allowing his patients to continue their ordinary mode of life, but had them measure the amount of fluid taken in and the quantity of urine voided.

In healthy people the latter usually is several hundred cubic centimeters less than the former, since water is given off also by the skin and lungs. If the amount of water taken in is reduced, in healthy individuals urinary excretion becomes almost correspondingly less; but in subjects suffering from circulatory disorders this decrease is very slight or does not occur at all. That is, by Oertel's plan of treatment an excess of water was removed from the body, circulation was relieved, the amount of circulating blood was reduced, and the restoration of normal conditions was favored.

Oertel assisted this principle of removing superfluous water not only by restricting the amount of fluids taken in, but also by other measures, such as exercise, hot baths, etc. He investigated the effect of his treatment on the various forms of circulatory disorders, employing all the methods then available. Determinations of blood pressure, hemoglobin, of the concentration of the blood, and its amount, appear prominently in his reports. In addition, he also devoted much attention to nutrition in general. In obesity, the removal of water was combined with measures for reduction of the amount of body fat, a principle that he carried out in a more rational manner than did Ebstein. If the patients were emaciated, he endeavored to produce an increase in their weight, and so on. So

far as the quantitative composition of the diet was concerned, he based his mode of procedure on the observations of Pettenkofer and Voit; that is to say, he had already adopted practically our modern point of view. But I might mention that his principle, the prescription of much protein in the food, is at variance with the restriction of fluid taken in, as I will point out later. When the disturbance of circulation was associated with edema, he regarded the condition as lying outside of the scope of his specific treatment. This he considered as especially applicable in the moderate circulatory disturbances attending arteriosclerosis, cardiac weakness, and obesity.

Oertel must be regarded as the father of the scientific dietetic treatment of circulatory disorders as founded on theoretical considerations and the rational application. At present we do not agree with many of his conceptions, but the principles on which his method was founded are still in many respects remarkable.

Science achieved the most admirable triumph when it recognized the significance of the relation of sodium chloride to the circulation and the development of edema. It is to Widal that this conception is chiefly due. He started from theoretical considerations, and also from experiments at the bedside. After it had been established by various observations that sodium chloride was poorly excreted by the diseased kidney, he and Strauss simultaneously hit on the idea that it was precisely the retention of this substance which was the crucial factor in the production of edema and that gave rise to its appearance. We are all familiar with the brilliant experiments by which Widal furnished irrefutable proof of this conception.

I know of few observations in the whole history of metabolic treatment that can be compared to this for simplicity, clearness, and ease of demonstration. It is a classic experiment. With this single experiment, the result of which has frequently been corroborated, the predominant part which sodium chloride plays in the retention of water was definitely proved.

The important part played by this substance in the water content of the diseased body can also be demonstrated for the healthy

individual. Permit me to make a few observations in this connection. The various organs possess a definite content of sodium chloride which is much less than that of the blood. The muscles are poorest in sodium chloride, containing only 0.1 per cent., while the connective tissue, with 0.3 to 0.4 per cent., is richest. According to my analyses, the total amount of salt in the body of a healthy man may be estimated as 130 grams. Owing to the fact that we take in a considerable amount of table salt, about 15 to 20 grams a day, the body always contains an excess of sodium chloride above the minimum. When a healthy person fasts absolutely or takes his ordinary diet without the addition of any salt, he gives up 10 to 20 grams of sodium chloride. At the same time he loses 1 to 2 kilograms in weight, without, however, sacrificing protein and fat. He gives up 1.5 liters of fluid—*i. e.*, lymph. If, now, 15 to 20 grams a day of salt are added to the salt-free diet the healthy body does not during the first days excrete this amount completely, but retains the 15 to 20 grams originally lost, and at the same time corresponding quantities of water, 1 to 2 kilograms, are again stored up; in other words, the excess of sodium chloride which is retained by the body on a normal diet and under normal conditions does not contribute to an increased concentration of the juices in this substance, but demands its own amount of water for solution, and in this way augments the quantity of fluid circulating in the body.

This fact having been established, Oertel's conception of restriction in the ingestion of fluid must be subordinated to the task of reducing the sodium chloride. Whenever this is cut down, thirst becomes less and the amount of water taken is decreased in the natural course of events, without imposing on the patients the restriction of fluids.

In general, it may be said that the salt-free treatment has only seldom been carried out in its most radical form, as it had been applied by Widal in his famous experiment. This is due to several facts; in the first place, to the lack of persistence of physicians and patient. While the principle of the salt-free diet appears simple enough to apply, practically it requires thorough knowledge

on the part of the physician and much energy on the part of the patient. The physician will always be more inclined to reduce the edema by stimulating renal activity with drugs rather than by the principle of protective therapy.

In a large number of cases the desired effect may be obtained with theocin, diuretin, digitalis, and so on. When this is not the case, the physician sometimes prescribes a salt-free diet, but promptly abandons this if it is not quickly effective. I should like to give an example of the amount of persistence and care required, and of what excellent results may then be obtained even in desperate cases. Last winter I found in the Friedrichshain Hospital two patients with severe parenchymatous nephritis and enormous edema. Both of these had been treated for five or six months with all sorts of remedies. Digitalis and digalen, theocin, diuretin, theobromine, potassium acetate, calomel, purgatives, hot packs, and scarification had all been systematically resorted to in the course of half a year without leading to any permanent improvement. I now gave both patients a full mixed diet with meat, eggs, potatoes, vegetables, milk, bread, zwieback, and fruit, without excluding any article of diet, without the addition of the least traces of salt. The bread, zwieback, and butter also were made without the addition of any salt. In the case of one patient, a boy of fourteen, the weight in the course of three weeks fell from 55 to 40 kilograms, but that of the other changed but little. My colleague, Stadelmann, who knew the patients of old, expressed the opinion that but little result was to be expected. In the next four weeks, however, the patient lost 30 kilograms in weight, and the last trace of his edema disappeared. During these four weeks he had excreted about 300 grams of sodium chloride. In the first three weeks the kidney had been only slightly permeable for the salt, and therefore but little water could be removed from the body. After the excretory power of the kidney had been spared (*geschont*) during the first weeks, a period of greater activity followed, which quickly brought about the complete removal of the edema. In such difficult and desperate cases not only persistency and stern determination are necessary, but also the strongest restriction of sodium chloride.

The patient received about 2 to 3 grams of sodium chloride a day in his food. If he had been treated a little more laxly and had been allowed even 5 to 6 grams only, he would never have been freed from the edema.

The importance of this observation lies in two facts, namely, (1) that the salt-free diet had proved efficacious after all other therapeutic measures had failed; and (2) that it required fully seven weeks, in the first of which no distinct improvement seemed to be obtained.

The salt-free diet is most efficacious in parenchymatous nephritis. In this condition, in which the salt does not pass through the diseased kidney, its significance is perfectly evident, and the immediate therapeutic effect is most striking. But also in other forms of passive congestion, as in cardiac insufficiency and cirrhosis of the liver, the removal of salt from the food is often followed by surprising results. The mechanism is a little different from that in renal disease. In these conditions also a portion of the excess of sodium chloride is retained in the body, not, it is true, because the excretory power of the kidney is primarily impaired, but because of the circulatory disorder. The salt is retained in the body, together with corresponding quantities of water and other components, first, in the bloodvessels, then either as edema under the skin or as free fluid in the abdominal cavity. On cutting down the superfluous amount of salt taken in, the increase in the edema and the transudation ceases; this is followed by a certain equilibrium, and the mechanics of the circulation become more favorable. Now the kidneys begin to secrete more actively, and this is followed by removal of the edema. In many forms of broken compensation it is possible to bring about normal conditions solely by removing an excess of sodium chloride from the food, and without the assistance of any drugs. Even pleural exudates, whose development is lest dependent on the quantity of sodium chloride than that of congestive transudates, are sometimes favorably influenced by a salt-free diet.

Let us now ask, What is the relation between the different so-called treatments of Karell, Oertel, and Widal, and how have we

to judge them from a theoretical and from a practical standpoint? The Widal treatment has this in common with the strict milk cure of Karell, namely, the small amount of salt that is allowed the patient. Indeed, it was Widal who explained the well-known efficacy of the milk diet in nephritis by pointing out the small amount of salt present in this fluid. The salutary properties of milk depend not on any positive characteristics, such as a peculiarity in the nature of the protein molecule, or a specific diuretic action of the milk-sugar, the fine subdivision of the fat in an emulsion, or on any particularly favorable mixture of these substances, but rather on a negative quality, its poverty in sodium chloride. But even milk may be too rich in salt when given in large amount, and Widal has particularly emphasized this fact. Three liters of milk, which is the minimum amount necessary to maintain equilibrium, contain 5 grams of sodium chloride, and this is more than many a diseased kidney can excrete. A mixed diet of meat, eggs, bread, etc., like that referred to above, contains only 1.5 to 2 grams of salt, if none has been added.

Whereas Karell's diet is similar to that of Widal in the low quantity of salt, it differs from that of Widal in the great reduction in the amount of all foodstuffs. During the first week the patient does not receive even a fifth of his requirements, and during the first five to six weeks the physiological minimum is never reached. During this time the patient accordingly loses considerably in body protein and fat. The principle of Karell's treatment, therefore, consists in a reduction of the amount of all the foodstuffs allowed. In many cases it is more suitable than the Widal treatment, when this is carried out in the manner in which Widal performed his celebrated experiments. But it must not be overlooked that Widal in the above instance made use of a full dietary, with 120 grams of albumin, 170 grams of carbohydrates. and 100 grams of fat, in order to exclude all other factors and to demonstrate the predominating *role* of sodium chloride in water metabolism. In every-day practice not only is it unnecessary to carry out the treatment in this way, but it may even be injurious for the following reasons:

The ingestion of all organic foodstuffs increases the amount of fluid in the body in a manner similar to sodium chloride, though not to quite so marked a degree and by a somewhat different mechanism. Fat appears to do this least, although for the purposes of its absorption a certain amount of bile, pancreatic juice, and intestinal juice is poured out; but as it does not dissolve in the body juices and is only emulsified by these, its further transportation through the lymph and bloodvessels does not require the assistance of water. The absorption of the carbohydrate demands considerable amounts of water, since the glucose content of the blood serum rises only from 0.1 to 0.3 per cent. at the most. But as soon as the glucose molecule has been deposited as glycogen, or has been oxidized, it makes no further demands on the water supply of the body. The water metabolism is most strongly influenced by the protein molecule. Not only does it require for its absorption and its transportation in the body relatively large amounts of water, but its end products, urea, uric acid, etc., also demand considerable amounts of fluid for their excretion. It is for these reasons that the ingestion of much protein makes greater claims on the water supply and on the organs of circulation than do other foodstuffs.

The relationship of the protein metabolism and of sodium chloride to the water metabolism is particularly well shown in diabetes insipidus. In the true forms of this affection it is impossible to control the increased excretions of urine by applying only Oertel's principle of restricting the ingestion of fluid, but thirst and the amount of urine excreted immediately become less when the amount of salt taken in is reduced from 20 to 5 grams. The same thing happens if the quantity of albumin is cut down from 102 grams to 60. Instead of 40 grams of urea produced under the former conditions, now only 20 are excreted and the quantity of urine may be diminished by several liters more. In a similar way, the reduction of the amount of protein in the food is of benefit in all circulatory disorders, though the effect is not quite so noticeable as in diabetes insipidus. In each instance the work of the vascular system and of the kidney is lightened.

RECAPITULATION

To recapitulate, we are in possession of three methods of reducing the amount of body fluids, and, in this way, effecting the dehydration of the body; in the first place, by lessening the amount of water ingested (Oertel's treatment); in the second place, by the reduction of the sodium chloride taken in (the cure of Widal); and in the third place, the use of a restricted dietary, especially poor in protein (Karell's cure).

Besides Oertel, the somewhat unreliable Schweninger, and the layman Schroth, von Noorden has laid emphasis on the reduction of the fluid intake. Von Noorden found this measure particularly efficacious in the polyuria of contracted kidney and in advanced arteriosclerosis. The reduction of the fluid taken in from 3 or 4 liters to 1.5 to 2 liters was followed by a great improvement in the condition of the patients. In many instances the blood pressure fell 30 to 40 mm., the nocturnal polyuria became less, and the nocturnal attacks of angina and asthma ceased, especially when no fluids were taken in the course of the evening. Von Noorden has demonstrated that 1.5 liters of urinary water suffice in cases of contracted kidney for the removal of all the products of metabolism, and that there is no danger of uremia under these conditions. In such cases, in which a great excess of water had previously been taken, the effect of reducing its intake is very pronounced, and is readily explicable on theoretical grounds.

It is but rarely, however, that the effect of reducing the amount of water intake depends on this factor alone. As soon as this measure is enforced with some degree of strictness, so that the patient receives less than 1 liter of fluid per day, in most cases he will find it impossible to eat as much as before. This explains the well-recognized value of reducing the consumption of fluids in the various obesity treatments, as in that of Oertel, in that of Schweninger, etc. Schweninger allowed his patients to drink freely between meals, but forbade drinking at meals. The importance of this prescription evidently lies in the fact that, by forbidding

drinking at meals the amount of food taken is reduced. The same principle is to be found in the thirst cure of the layman Schroth, in which a further loss of appetite is caused by the monotony of the diet. But I wish to emphasize especially that, contrary to the views of the laity and to the erroneous theoretical considerations of Oertel, Schweninger, etc., lessening the amount of water does not increase the oxidation of fat. This happens only in the most extreme forms of thirst cure, after the method of Schroth, when fever, abnormal decomposition of proteins, and other dangerous complications occur. On the contrary, it is possible with proper management to carry out obesity cures not only without cutting down the water ingestion, but even by giving large amounts of fluid, as has been suggested recently by G. Rosenfeld. This clinician favors filling the stomach and intestine as much as possible with water, in order to control the subjective sensation of hunger. It is possible that these large amounts of water may stimulate metabolism and the oxidation of fat. That this is true has apparently been demonstrated by Heyl.

I believe that the effect of reducing the amount of fluid alone is seldom dependent on this factor only, as, for example, in chronic interstitial nephritis. In general, the measure acts indirectly by inducing the patient to become unconsciously more abstemious in eating and usually to avoid strongly salted food which increases thirst.

The reduction of sodium chloride is indicated especially in the edema of parenchymatous nephritis, but it is also useful in combating some of the symptoms of contracted kidney, such as headache, uremic asthma, angina pectoris, and pulmonary edema. Diabetes insipidus and cirrhosis of the liver also require mention in this connection. It seems to me that it is wrong to allow patients who have been relieved of dropsy and other chief symptoms by a Widal treatment to return to their ordinary salty diet. Although the excretory capacity of the diseased kidney undergoes considerable improvement after a period of functional rest, so that it may at times be rendered capable of excreting 5 to 10 grams of sodium chloride instead of only 1 to 2 grams, it would be wrong to impose

on it a normal amount of work. In cirrhosis of the liver, I also attach much importance to a long-continued reduction in the salt intake. While the re-accumulation of ascites after aspiration does not depend exclusively on an excess of ingested sodium chloride, this is none the less an important factor. I would call attention to Achard's instructive case of cirrhosis of the liver, in which he succeeded in removing the ascites five different times by enforcing a salt-free diet. Patients with diabetes insipidus must permanently refrain from a salty diet, since it is impossible to improve the capacity of the diseased kidney for excreting concentrated urine.

I now come to the third point, the reduction of the protein intake. I have already indicated that Oertel's two principles of low water and high protein intake—he required up to 200 grams of protein a day—are at variance with each other. His regulations date back to a time when the study of metabolism was chiefly concerned with the behavior of the proteins, and the maintenance of the nitrogen equilibrium was held to be the most important consideration from a therapeutic standpoint. At that time it was believed that the bodily weakness which sometimes appeared in rapid obesity cures was due to a loss of muscle protein, particularly by affecting the heart. But I should like to call attention to the fact that a loss of albumin content and of muscle volume by no means invariably leads to impairment of the capacity for bodily work. (This is plainly evident when persons unused to bodily exercise take up some mild form of sport, especially moderate mountain climbing. In spite of the fact that there is at first a prompt loss, both of fat and of muscle tissue, the cardiac and body musculature improve greatly in functional capacity.) Felix Hirschfeld was the first to oppose the theory that a patient with heart disease should be protected against further weakness by abundant food, particularly by the administration of large amounts of protein. His firm stand in this respect was well grounded. He showed that reducing the amount of water alone did not suffice to restore compensation, but that it was necessary at the same time greatly to cut down the food taken as a whole. His opposition to Oertel's teaching is entirely correct on this point, and this has been demonstrated by many clinical observations.

In addition to its immediate effect on water circulation, a diet poor in proteins probably acts favorably in other directions also. Chittenden has called attention to its advantages in healthy persons, without, however, being able to explain this result in detail. In some diseases we can plainly demonstrate the harmfulness of a diet rich in protein, as, for example, in diabetes mellitus. In this condition it impairs the tolerance for carbohydrates, sometimes to a most pronounced degree. In opposition to Oertel's opinion, reduction in the ingestion of protein is particularly to be recommended not only in cases of broken compensation, but also in the case of cardiac patients who were previously high livers and exhibit a certain degree of plethora. It is also particularly indicated in the later stages of chronic interstitial nephritis, when uremic manifestations of greater or less severity appear. These are due largely to the retention of nitrogenous end products of metabolism. I do not wish by any means to go to extremes and recommend always a minimum of protein in such cases, but I do consider it more advantageous for a nephritic in his last years to sacrifice a few kilograms of weight on a scanty protein diet and feel fairly well, rather than to maintain his weight at the expense of chronic uremic manifestations.

What shall be our attitude in regard to these forms of treatment in an individual case? I think that it is best if we first attempt to carry out each one of the three treatments exactly according to the directions of Karell, Oertel, and Widal, in suitable cases. Only in this way can we form a correct opinion of their principles and their utility. Each one of these principles of water removal is attended by certain difficulties in its practical application, and these can best be overcome at first by strict adherence to the rules laid down by the three authors. When we have done this a few times we shall be able to deviate from the regulations and modify them in detail. Then we shall be able to determine whether it is more advantageous in a given case to secure relief for the circulation by restricting the intake of water, by a salt-free diet, or by reducing the amount of albuminous food, which, as a matter of fact, reduces itself to forbidding or restricting the consumption of

meat, but sometimes also of milk. In the Karell treatment I consider it particularly important to adhere carefully to the four-hour intervals between the separate portions of milk allowed the patient. It is frequently necessary to use skim-milk, as Karell advises, in order to accustom the stomach of the patient to the monotony of the milk diet.

The salt-free diet of Widal is theoretically easy to administer, but one is apt to encounter the opposition or lack of comprehension of the cook. It is hardly necessary to forbid any article of food if only it is given in its natural condition and without any addition of salt on the part of the human hand. Of the fresh articles of food, only salt-water fish are to be excluded. The butter should be unsalted and the bread must be specially baked without salt. Of course, all forms of preserved meat and fish, as well as cheese, must be avoided, for these contain a great deal of salt. Milk also can be permitted only in small amounts, for it contains about 2 grams of sodium chloride per liter. By giving chiefly cereals, oatmeal, rice, hominy, custards, jellies, puddings, fruit, and desserts, the lack of salt is made more endurable to the patient.

If we wish to allow a patient a certain amount of salt after he has been for some time on a salt-free diet, we should not content ourselves with the general direction that he shall use moderation in salting his food, but prescribe a definite amount that is allowed. The conditions are comparable to those in diabetes mellitus, in which instance it is necessary to give the patient the most precise directions. I, myself, manage in this way: I have the food prepared without salt just as during the strictest period; then I give the patient small, accurately weighed quantities of salt, say 2, 4, or even 6 grams, and permit him to add this salt to his food in whatever way he wishes during the twenty-four hours.

The dietetic measures are just as important in the treatment of circulatory disorders and renal diseases as is the dietetic treatment of the glycosurias. I should feel much gratified if what I have said should enable any to gain a deeper comprehension of the principles involved and to apply them more widely than before.

DISCUSSION

Dr. James Tyson: As far back as 1890 I published a paper upon what I called the management of obstinate dropsies. In this paper I advised the use of a pure milk diet in moderate quantities. The effects were very striking, and I have continued since that time to use this treatment in cases of obstinate dropsies.

The explanation which appeared to me most simple was that I was presenting to the patient an easily assimilated diet and a limited quantity of water. The *rationale* is plain. In a water-logged patient there is already too much water in the economy, and one of the reasonable ways to help get it out is to add as little as possible to it. My experience as to the different affections in which the treatment was useful resulted, as that of others who have tried it, in finding it more valuable in the dropsies of heart disease than in those of renal disease, although it is also valuable in the treatment of the latter. The chronic parenchymatous cases give us the most trouble. The quantity of food being very limited, my experience was that as soon as the patient began to hunger, the improvement was observed. The dropsy diminished, the quantity of urine increased, and a favorable change took place in all the symptoms. I have continued this method with results on the whole more satisfactory than that of any other plan.

My experience with a salt-free diet has not been very satisfactory, though I confess to not having treated the cases through as long a period as I should have done, and I may have looked for results too early. My attempt, therefore, to use the salt-free diet I do not think has been a fair one.

I have been exceedingly interested in hearing Professor Levy's account of these valuable treatments—the salt-free diet, the limited water ingestion, and the limited proteid ingestion.

Dr. Hobart A. Hare: The work which was done many years ago by the various physiologists in European laboratories in regard to the influence of isotonic solutions upon the salt content of the various tissues of the body has some bearing upon the question before us. The point which Professor Levy brings up has a practical bearing which he has not mentioned, and which perhaps he will think is not sufficiently cognate to justify me speaking of it—that is, the administration of purgatives in cardiac or renal dropsy. We know that the various saline purgatives act in more than one way. If we give purgatives to a man water-logged from nephritic trouble, we practically concentrate the salt in his tissues and produce an artificial condition which is practically like that we produce when we permit him to eat freely of salt.

It was also interesting to have Professor Levy tell us about the carrying out of the salt-free diet in patients not only water-logged but in patients with well-

advanced uremic symptoms. I have a patient at this time under my care who presents as severe a condition of parenchymatous nephritis as I can conceive of. Her uremic symptoms are not so acute that we look forward to her death in a few hours, but the condition is sufficiently grave to make me hesitate to institute a method such as that described by Professor Levy unless he can give us some facts which might lead us to believe that where there is associated toxemia any one of these three methods is advantageous.

Professor Magnus-Levy: It would be difficult to estimate what proportion of parenchymatous nephritis is benefited by a milk diet. Dr. Tyson referred to the low quantity of water intake. In my experience with parenchymatous nephritis, the water taken does not play such an important *role* as the salt intake. I want to emphasize also the point that decreasing the amount of salt taken in naturally decreases the amount of water that will be taken. The diet employed by Widal was in no way different from the ordinary food except in the withdrawal of salt.

An interesting point is that in the last winter I was able to relieve a patient from edema who had been unsuccessfully treated by all the other methods. It is desirable to supervise the diet of the patient throughout, for the cook often does not know how to prepare the food. There are cases of parenchymatous nephritis in which the salt-free diet will not be efficacious, but this does not contraindicate its use. There are some cases in which digitalis does not do good.

I do not wish to say that other forms of treatment are superfluous or not efficacious. Dr. Hare has insisted upon the efficacy of purging. The fluids given up by purging are not so rich in salt as blood serum. Dr. Hare was right in saying that there will be little increase in the amount of concentration of salt in the body. What will occur in the sweating cure, when the patient does not drink salt water but takes ordinary water? He fills up with the water which he lost but he does not fill up with salt. There is sometimes danger of increase of amount of concentration of salt. The sweating and the loss of water by the intestines, and purging, may be of great benefit when the kidney is impaired. I have never seen bad results from a salt-free diet in uremia of parenchymatous nephritis, and I would beg Dr. Hare to repeat the dangers which he thought to be the result of such a diet.

Dr. Hare: I do not quite understand the theory upon which Professor Levy bases his treatment. The understanding which I have is that the rest of the kidney being protected by not having an excess of sodium chloride to eliminate, this organ is able to deal more largely with the watery constituents of the body which it eliminates, and thereby diminishes dropsy. I would ask if he will kindly explain exactly the way in which he thinks that depriving the patient of salt results in the diminution of fluid in the tissues. If this theory is carried out to its conclusion, it ought to be possible to give

patients distilled water and then follow this up by some active purge, thus getting rid of the salt more quickly than by salt starvation.

Dr. John H. Musser: I am sorry that I have not with me some charts illustrating the benefits derived from this treatment. I rise only to state that I have had the pleasure of seeing extraordinary cases of edema relieved by this method in several instances during the winter, and my associate, Dr. Goodman, will publish these cases before long. They confirm in a remarkable way Professor Levy's method of treatment.

Dr. Levy closes: I am glad to hear Dr. Musser's confirmation in the results which he has obtained by this treatment. I wish to emphasize my statement that I have not brought to you a treatment of my own, but the treatment of Widal. The glory must be ascribed to the name of Widal.

I should like to answer Dr. Hare's question by asking another: that is, whether such an experiment as he suggests has been made in his clinic? I should say that it might be possible in some cases to relieve the patient by the method suggested; but how long could you keep a patient under such a treatment of combined purgatives and water? In two or three days the patient would be more harmed than benefited. On the other hand, this treatment which I have advocated can be continued for weeks and months.

As to how this mixture of sodium chloride acts, we may assume that in the cases treated by Widal the kidney was not very much interfered with. The patient received 5 grams of sodium chloride. The function of the kidney is improved under the treatment, so that a larger amount of urine is excreted.

PAROXYSMAL PULMONARY EDEMA AND ITS TREATMENT[1]

By ALFRED STENGEL, M.D.
PROFESSOR OF CLINICAL MEDICINE IN THE UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA

The condition designated paroxysmal pulmonary edema cannot well be mistaken for any other. It comes on very suddenly with little or no premonitory indication and rapidly assumes such alarming characters that the patient and those about him feel that a fatal termination can be a matter of but few minutes. The patient at the very beginning experiences a sense of suffocation or oppression of breathing which speedily becomes extreme. He struggles for breath, and soon becomes additionally oppressed by paroxysms of suppressed cough, in which a little frothy and often blood-tinged serous fluid is brought up. Later, large quantities of the same sort of frothy serum may be expectorated or may literally well up from the lungs. The breathing is merely moist on auscultation or noisy, according to the degree of edema; in severe attacks it becomes suppressed. When the frothy expectoration has stood for a time in a vessel the bubbles of air disappear, leaving a clear and usually blood-tinged serous fluid.

At the moment of the attack the patient grows suddenly deathly pale and wears the anxious expression of terror of one who fears instant death. The hands, feet, and whole body grow cold and become bathed in a dripping sweat. Later, as the respirations grow more and more difficult, cyanosis becomes associated with the pallor. Extreme cyanosis, however, is uncommon. The pulse, usually extremely weak and rapid in the beginning, may continue

[1] Read February 2, 1910.

so until some relief is afforded. In some of the seizures in cases reported in this series the pulse during the early part of the paroxysm was almost imperceptible, and improved very gradually as the attack subsided. Occasionally, however, the pulse may be rapid and excited during an attack and may give no evidence of reduced cardiac power. It will be shown later that even in such cases the actual working power of the left ventricle may be diminished, and that the mechanical conditions capable of developing pulmonary edema may be present despite the seeming strength of the pulse.

At the beginning of the attack the patient is usually nervous and frightened, and this condition may increase with the oppressed breathing and suffocating cough. Later, a certain amount of stupor or partial unconsciousness may develop, but this is unusual. After a time the patient grows easier; warmth returns to the hands, which have been cold and cyanosed; the breathing improves; the moist rales in the chest grow less abundant; color returns to the face; and the pulse grows stronger and less frequent. The majority of paroxysms terminate in this way; in but a small proportion of cases does a fatal termination occur, notwithstanding the extreme violence of the symptoms usually observed. Some patients have, however, died in the first attack; others have survived for a period of months or years, despite repeated seizures. In Lissamann's[1] case there were seventy-two attacks during a period of over two years; and the patient was living at the time of the report. In one of my cases paroxysms have occurred at intervals of weeks or months, during the last ten years; and the patient is now in rather better physical condition than after the first attack in 1900.

The distinguishing features, clinically speaking, of the condition that has been referred to are its sudden onset, usually with slight provocation; the evidence of intense pulmonary edema; the expectoration of quantities of frothy and blood-stained serum; and the repetition of such attacks without intercurrent complicating con-

[1] Lancet, February 8, 1902.

ditions. These features distinguish this condition from certain other forms of acute pulmonary edema, which, during their height, may not be especially different in clinical manifestations.

The seizure, as a rule, comes on in the evening or after the patient has gone to bed. He may awake from a profound sleep with an oppressed cough, followed by the symptoms described. In some cases, vague apprehensions or unaccountable nervous feelings may precede the attack; but these usually occur only after a repetition of the seizures has made the patient familiar with their character and fearful of their recurrence. Various kinds of excitement, physical or mental, may provoke the attacks; but in a large proportion of cases there is no such cause.

Repeated attacks of the same character may occur at intervals of days or weeks during a long period of time. In one of my cases the seizures began over ten years ago and have continued up to the present time at varying intervals. Between attacks the patient may be perfectly well, or more frequently give evidence of some inadequacy of cardiac compensation. In the cases which have terminated fatally the final result has usually been due to increasing cardiac decompensation rather than to the sudden effect of an attack of pulmonary edema.

It is necessary to point out here some of the other varieties of acute pulmonary edema met with clinically, so that the limitations of what is intended to be included under the title paroxysmal pulmonary edema may be more evident.

1. Acute Edema Associated with Other Lesions of the Lungs. It is a well-known fact that cases of pneumonia or pulmonary tuberculosis may terminate suddenly by the development of an acute edema affecting a part or all of the lung not involved in the original trouble. The explanation offered for such cases by older writers, and to a large extent still accepted, is that there is a collateral hyperemia or fluxion, resulting from the extent of the original trouble. Another explanation is, however, possible, particularly in cases of acute pneumonia. This is that, as a result of dissemination of the infective cause, an acute inflammatory edema of the entire lung or of both lungs follows after the original

infection. In this condition there may be a close resemblance in the symptoms to what has been described before, but the history of the case and the circumstances under which the acute edema arises distinguishes this from paroxysmal edema.

2. Acute Infectious Edema; Acute Inflammatory Edema; or Acute Edematous Inflammation. This condition, which was originally described by Traube as serous pneumonia, or diffuse congestive pneumonia, may occur in association with certain infectious diseases, such as scarlet fever, smallpox, typhus fever, rheumatism, or influenza, or as a primary infection of the lungs. Its resemblance to vagus pneumonia is too close to be overlooked; and its occurrence in cases of acute cerebral disease, head injuries, or sunstroke is likewise suggestive. Strümpell[1] alludes to such cases, and mentions the absence of other lesions than the edematous lung. Hilton, Fagge[2] and Fowler[3] describe the same condition. Sahli[4] insists that this is purely an infectious condition; and Kockel,[5] in his pathological and bacteriological study of six cases following head injury, found a constant association of bacterial invasion and the acute inflammatory lesions. He further states that Thoma believes that most diffuse or extensive edemas are inflammatory and infectious, and mentions that Ziegler describes such cases as "septic-toxic" edema. Welch[6] states that he agrees with Sahli regarding the frequency of infectious inflammatory pulmonary edemas, basing his opinion upon the systematic bacterial examinations made at all autopsies at the Johns Hopkins Hospital. Not only in irregular and localized edemas, but also in not a few extensive and even general ones, plate cultures from the lungs showed numerous colonies of bacteria, most frequently streptococci and lanceolate micrococci, so numerous that they must have been in active growth in the lungs. Sudden edema associated with Bright's disease, described by Dieulafoy[7] and by

[1] Text-book on Medicine, second American edition, p. 183.
[2] Text-book on Medicine, third edition, i, 1002.
[3] Diseases of the Lungs, p. 281.
[4] Archiv f. exper. Pharm. u. Path., 1885, 19.
[5] Deut. Naturf. und Aerzte, 1896, lxviii, 30.
[6] Quoted by Meltzer, "Edema," American Medicine, viii, Nos. 1 to 5.
[7] Path. int., thirteenth edition, T. I., i, 282.

other French writers, may, in some cases, belong in this same group, but is possibly susceptible of another explanation, similar to that which will be suggested in the case of paroxysmal edema.

The clinical manifestations of acute infectious edema, as I have seen them in some cases of influenza and other infections, do not differ greatly from those of paroxysmal pulmonary edema, except that there is much less suddenness and vehemence of the symptoms. Certain authors (as Romberg) have mentioned as distinguishing features the fact that there is fever in these cases, and usually a pulse suggestive of increased rather than lessened cardiac action; and undoubtedly these are important points, and may lead to a proper diagnosis. It must, however, be recalled that fever is not invariably present, and that in some instances of paroxysmal pulmonary edema the pulse rate does not give evidence of decided cardiac weakness. A more important criterion for distinguishing the two conditions is the tendency to recurrence in the one and the absence of such a tendency in the other. Furthermore, paroxysmal pulmonary edema, as will be pointed out later, occurs in association with certain other conditions, cardiovascular or renal, and rarely independently of such causes; while infectious edema may appear in persons previously in perfect health. Later, in the discussion of the pathogenesis of the pulmonary condition in paroxysmal cases, I shall have occasion to point out that infection has been thought of as the important etiological factor. A series of paroxysms would, therefore, necessarily imply a series of successive infections. Such an occurrence is manifestly most unlikely, and all the facts connected with the recurrent paroxysms in cases such as those observed by myself over long periods of time speak strongly against this possibility.

3. Acute Edema Accompanying Rapid Dilatation of the Heart. In cases of acute dilatation of the heart caused by acute myocarditis or degeneration of the heart, considerable edema of the lungs may develop quite rapidly; and the clinical features at the height of such an attack may be indistinguishable from those which occur in seizures of paroxysmal edema such as have been described. The manner of onset and the coincident conditions,

however, distinguish such cases from the paroxysmal type; for there is usually a clear history of preceding acute cardiac weakness, and, perhaps, even prior to that, of some infection which has occasioned it. Then, too, physical signs of increasing cardiac weakness and of increasing dilatation of the heart precede the onset of the pulmonary edema. Thus, it is usually possible to distinguish the two conditions, notwithstanding the fact that at the height of the symptoms they are practically indistinguishable, as cardiac dilatation quite commonly occurs as an incident of the attack in the paroxysmal variety.

While we may thus recognize four types of sudden, or acute, edema of the lungs, it must be apparent that the first is clearly distinguished from the others mainly by its recurrent character; and for this reason, I have ventured to use the term *paroxysmal pulmonary edema.* Among other names that have been suggested is acute suffocative pulmonary edema, but this is less descriptive, because practically all forms of acute edema are almost equally suffocative in character.

A report of some typical cases will serve to indicate the clinical features.

Case I.—Mr. E. B., aged seventy years, at the time of his death, in May, 1909, had been under my observation for six or eight years. He had formerly been addicted to the overuse of alcohol, and was an inveterate smoker. He came of a distinctly gouty family, and he himself suffered from a moderate obesity and later from a mild glycosuria, which came and went. During the time he was under my observation I recognized the development of increasing arteriosclerosis, and examinations of the urine showed traces or small quantities of albumin and tube casts significant of an increasing interstitial nephritis. The blood pressure was constantly high, and increased with succeeding years. During the last four years of his life the sugar had disappeared from the urine. None was present from January, 1905, up to the time of his death.

The first attack of pulmonary edema occurred during the winter of 1908, after a somewhat heavy dinner. The patient had gone to the theatre, and while there complained of the heat of the room and of oppression of breathing. He was quickly hurried out before the attack developed, but he could not get to his home, and when I reached him, fifteen minutes later, in an adjoining house, where he had been taken, I found him in the midst of an attack of the most intense severity. The pulse was scarcely palpable, the face was livid,

and the skin everywhere icy cold and bedewed with dripping perspiration. The breathing was noisy and the lungs were evidently edematous throughout. A physician who had seen him before my arrival had given him a pearl of nitrite of amyl, which was inhaled from a handkerchief with apparently some slight relief. I gave him a hypodermic injection of morphine with atropine, and in a short time he was sufficiently restored to be taken home; but subsequent hypodermic injections of strychnine, nitroglycerin, and atropine were given, as the patient was greatly exhausted. After an hour he fell asleep, and the next day was practically well, though much exhausted. After this attack the patient had a succession of similar seizures, probably fifteen in all, none, however, of the intensity of the first, and in each of these the prompt administration of hypodermic injections of morphine, sometimes with and sometimes without atropine, relieved him speedily. The general course of his case, however was a downhill one, and finally increasing edema and other evidences of cardiac failure terminated the condition. Toward the end it seemed to me as if he might perish in one of the attacks on account of his generally weakened condition and the progressive deterioration of cardiac strength, but there never was any difficulty in controlling the seizures themselves. The final outcome of the case and the progress was practically the same as that of a case of general arteriosclerosis with cardiac disease unattended with such paroxysms of pulmonary edema.

Case II.—Mrs. H. E. R., now aged fifty years, first came under my observation in December, 1900. She had had a severe attack of cardiac disturbance of some sort a short time before that date, and when I first saw her she was still suffering from some of the consequences of a disturbance or a loss of compensation. The principal symptoms were dyspnea, cough, and other indications of pulmonary congestion. On physical examination I found slight enlargement of the heart and the evidences of mitral stenosis. After the administration of moderate doses of cardiac tonic, compensation became restored and the patient was quite well until February, 1902, when a sudden attack of intense congestion and edema of the lungs with cardiac weakness occurred in the middle of the night. Another attack occurred in March, 1902, after which she remained free of seizures, although at times not entirely well, until the spring of 1906, when she was greatly reduced by hemorrhoidal bleeding, and in May she had another severe attack of acute edema. The fifth attack occurred during the summer of 1906, the seventh about six weeks later, the eighth and ninth in October and December of 1908, the tenth in October, 1909, and the eleventh on January 28, 1910. All of these attacks have been of similar character and all occurred during the night. In several the direct cause was sexual excitement. In others, the patient has been awakened from sleep with a frightened feeling, which was quickly followed by intense oppression of breathing, a rattling sound in the chest, great weakness and rapidity of the

pulse, and the expectoration of more or less copious amounts of frothy and usually blood-tinged serum. Since the first attack, and up to the latest one, she has had the prompt attendance of a physician, who administered hypodermic injections of morphine with small amounts of atropine, and the result has invariably been a speedy recovery after a single hypodermic dose. In the last attack strychnine and nitroglycerin were used, and though the patient recovered from the attack, the duration was somewhat longer than on previous occasions, and the attack was one of no great severity, having been attended with but little edema and no frothy expectoration. The first attack of all was described as the most severe of the series, but I cannot give any details regarding it. After the attacks the patient quickly regains her normal condition, but during the ten years she has been under my care there has been the constant evidence of a cardiac defect, with slight dyspnea on exertion and a lowered general vitality. There has been no evidence of progressive loss of power in the heart, and the patient's general condition now is apparently quite as satisfactory as it was in the beginning. The physical signs of mitral stenosis, as is so common in cases of that lesion, are more distinct in the interval between than during or immediately following attacks. Urinary examinations have shown a slight trace of albumin on a few occasions, but not more than might be attributed to the leukocytes present as a result of some vesical trouble. The latest examination, made on the day following her attack of January 28, showed: specific gravity, 1018; reaction acid, no albumin, no sugar, no cylindroids or casts, a number of leukocytes, and some uric acid crystals. There has never been any indication in the urinary examinations or symptoms of nephritis.

Case III.—I. K., aged fifty years, first came under my care in 1901. He had used alcohol periodically to great excess, but not at all during the last year, and never subsequently up to the time of his death in 1909. He had, however, continued smoking immoderately, and never limited this at all reasonably until near the end of his life. In 1902 he suffered from an attack of abdominal pain, which Dr. J. Chalmers Da Costa and I regarded as due to appendicitis, but we decided it safer to avoid operation on account of certain cardiac symptoms. For some time previous to this date the patient had complained of substernal and precordial oppression, especially on slight exertion, as in walking up moderate hills on his golf course. The pulse was constantly rapid, and more so when he was specially oppressed. The heart sounds were weak but sharp, and the aortic second sound slightly accentuated. There was no cardiac enlargement and no murmur. In 1904 he had considerable anginoid pain, and in the summer another attack of what was regarded as appendicitis. Early in 1905 he had another abdominal attack, with pain most marked in the epigastrium. Soon after this he complained of a severe headache or neuralgia, which was followed by right homonymous hemianopia affecting

the right upper quadrant. Dr. de Schweinitz saw him and reported the condition "right lateral homonymous tetranopia." The vision improved after some time and possibly as a consequence of the use of potassium iodide. Another abdominal attack occurred later in 1905. In the meantime, his precordial distress never was wholly relieved, though it was less severe, or he had grown accustomed to it. During the summer of 1907 he had one or two attacks of severe cardiac distress while at some altitude in the Adirondack mountains; and in the spring of 1908 he had the first attack of threatening character. The description of the seizure, given by a friend who was with him, corresponded in every detail with that which would apply to subsequent attacks which I observed. A pellet of morphine and one of nitroglycerin were given, and after some hours relief occurred. I saw the patient the next day and found him in his usual condition, though somewhat used up by his experience of the night before. The cardiac signs were the same as those described. On the following night another attack occurred, and in this he developed a complete right hemiplegia with aphasia. Up to this time I had not seen the patient in an attack, but during the following eighteen months I saw him in several, and in others Dr. Klaer was called.

There was usually little premonition of the attack, but a certain amount of nervousness and mild oppression preceded the paroxysms for a short time. The attack itself set in very suddenly with extreme oppression of breathing, violent palpitation with great weakness of the heart beat and pulse, ashy pallor combined with some cyanosis, and cold sweat. Very soon he would begin to cough in short interrupted paroxysms, bringing up frothy serous fluid of pink color, and in bad seizures the same kind of frothy fluid flowed from his mouth between the coughing attacks. At the height of the attack the lungs were filled throughout with moist rales and the entrance of air was reduced to a minimum. Scarcely any inspiration or expiration could be distinguished.

During the eighteen months following the hemiplegia there were twelve such attacks or distinct beginnings of attacks and a number of milder suggestions. He was under the constant care of a nurse, who had been instructed to give a hypodermic injection of morphine, $\frac{1}{4}$ grain, and atropine, $\frac{1}{250}$ grain, at the first sign of a seizure, to be followed by one of strychnine sulphate, $\frac{1}{20}$ grain, and nitroglycerin, $\frac{1}{100}$ grain, within ten or fifteen minutes, and a repetition of morphine, $\frac{1}{8}$ grain, with atropine, $\frac{1}{250}$ grain, after a half hour if necessary. This plan never failed to abort the attacks within a few minutes and without any actual need for the second or third injection. In two or three of the attacks, when the nurse or members of the family thought the first symptoms merely nervousness, the attacks got greater headway and relief did not occur as speedily, but even then the patient was relieved in a half hour. The effect of the injections was to cause a rapid improvement in the oppression of breathing, followed by a fuller pulse, returning warmth of the extremities, and dimi-

nution in the frothy expectoration. The last four attacks occurred during the summer in Atlantic City, and Dr. Porteous reports that these were of the same character as previous ones, and up to the last one were controlled by a moderately large hypodermic dose of morphine and atropine, which on one or two occasions had to be repeated. The last and fatal attack differed only in being more severe than any previous ones Dr. Porteous had seen. It began while the patient was in a theatre, and possibly the delay in applying treatment may have been responsible for the fatal result. There was no autopsy.

Case IV.—W. H. S. was admitted to my service at the University Hospital in February, 1905, on account of cough, expectoration, and occasional hemoptysis. The patient was a shipper, aged twenty-two years, who had suffered from articular rheumatism four years ago, had been a moderate user of alcohol and tobacco, but without any other significant history. At this time signs of aortic regurgitation and mitral stenosis were discovered and a suspicious lesion was found at the apex of the left lung. We were never certain that this was a tuberculous lesion, as examination for bacilli was always negative and the cardiac condition could have easily occasioned a localized area of congestion. The patient left the hospital in April and was treated at a sanatorium for tuberculosis, where he remained until September, 1905, having gained considerably in weight, and being then discharged as cured. He attempted to resume his work, but soon noticed a return of blood-tinged sputum, and reëntered the hospital in the fall of 1907, with practically the same conditions we had previously found. The patient, however, had increased greatly in weight from the forced feeding, and we were under the impression that this increased weight had exaggerated rather than helped his cardiac difficulties. After a month's stay in the hospital he felt quite well, and was about to go home, when some little excitement incident to his departure from the hospital caused a sudden attack of acute edema He had walked from the ward to the elevator, and there was seized with intense dyspnea and weakness, and was carried back to his bed. A severe attack of acute edema followed, the respirations increasing to 50, the pulse to 160 per minute. Considerable frothy material welled out of his mouth, and he was extremely cyanosed. Repeated injections of camphorated oil, digitalin, and atropine were given. Of the last, doses of $\frac{1}{80}$ grain were given every thirty minutes during four hours, but the attack did not subside for eight hours, after which there was a slight improvement. During this attack it was noted that the cardiac dulness increased to the left as well as to the right, and as the patient improved the following day this increased dulness seemed to diminish. A second attack occurred two weeks later, and was described as a very severe one. The symptoms were the same as those in the previous seizure. A hypodermic injection of morphine and atropine, followed by digitalin and camphorated oil, quickly terminated this attack, and the patient's condition was practically normal within a few hours. Five days

later a third attack occurred, and promptly yielded to a single injection of morphine and atropine. Three more seizures followed at intervals of a few weeks, after which the patient had no further attacks of this sort. He subsequently developed a fresh cardiac infection with pericarditis, and eventually succumbed to this. Repeated examinations of the urine showed either an absence of albumin or mere traces, and sometimes a few hyaline casts, but more often none at all.

Case V.—J. G., aged sixty-one years, had first come under my observation early in 1908, after an attack of cardiac palpitation and dyspnea, which had come on during the night. He was sent to the University Hospital, where he has been a patient off and on up to the present time. Examination showed evidences of general arteriosclerosis and chronic interstitial nephritis. The peripheral vessels were sclerosed and tortuous. The blood pressure has varied from 200 to 240 mm. systolic, and 130 to 145 mm. diastolic. There is more or less constant polyuria, and the examinations have shown traces of albumin with hyaline and granular casts. Since his first admission to the hospital there have been a number of attacks similar to the one he described as having occurred before admission. The first of these which occurred in the hospital is described as follows: "The patient was suddenly seized with an attack starting with eructations, followed in a short time by coughing and expectoration of frothy material. Dyspnea became very marked, making it impossible for him to breathe unless sitting up in bed. A hypodermic injection of morphine caused a relief, but a return of the attack required a second injection." All the subsequent attacks have been similar to this. Their onset has been sudden and without marked premonition. The lungs quickly become moist and breathing seriously oppressed. A hypodermic injection of morphine with atropine quickly terminates the seizures.

On account of the renal condition, the patient has had constant hot packs at intervals of two or three days, and his general condition has remained practically stationary. Lately, however, a slight increase in the frequency of the attacks has been noted, and their sharp demarcation from his average condition has been less distinct, as the breathing remains somewhat oppressed and the lungs slightly congested between the seizures. Some tests as to the relative value of injections of morphine and of morphine and atropine in the recent paroxysm seem to show a moderate advantage in the latter over the former.

The progress of this case has been from a condition of practical comfort for long stretches punctuated by sudden intense seizures, from which the patient quickly returned to his usual condition, to one of more frequent but less severe attacks with a more lasting state of pulmonary congestion and edema between the paroxysms.

Etiology. The explanation of paroxysms of sudden pulmonary edema may be sought: (1) In a study of the conditions in which

such paroxysms have been encountered, and (2) in the experimental and physiological data bearing upon the question.

1. *Associated Pathological Conditions.* Several authors have summarized the literature of acute pulmonary edema, and have made tables of the various conditions with which it was associated. Samuel West[1] mentions as a rough classification of the causes of acute edema: (1) Acute inflammation; (2) acute collateral fluxion; (3) sudden mechanical obstruction to the vessels; (4) acute fevers; (5) certain poisons; (6) hyperpyrexia; (7) acute nephritis; and (8) paracentesis thoracis; and in the detailed discussion of these groups speak of various diseases which fall under one or the other of the headings. Riesman[2] mentions, among the associated conditions in reported cases, arteriosclerosis, Bright's disease, heart disease, asthma, acute infectious diseases, pregnancy, paracentesis of the thorax and of the abdomen, angioneurotic edema, obscured conditions of questionable relationship (hysteria, etc.).

It is evident that the acute edema which occurs in some of these conditions is not strictly comparable to the paroxysmal type which is under discussion. Thus, the sudden edema occurring after paracentesis or in some violent infection, such as scarlet fever, very probably results from different causes than those which are operative in the cases in which one paroxysm after another has occurred more or less spontaneously. To say the least, there must be an added factor of etiology that determines such recurrences of edema, and more probably the etiology is entirely different. In the case of infectious acute edema, for example, it is very probable that the direct action of the microörganisms upon the pulmonary vessels and the adjacent tissue is the immediate cause and it is inconceivable that repeated attacks of paroxysmal edema are due to repeated acute infections. The same thought applies to the probable mechanical disturbances operative in the edema following paracentesis. It is necessary, therefore, to distinguish the conditions with which acute edema has been associated as a recurring paroxysmal event from those in which there have

[1] Diseases of the Organs of Respiration, 1902, i, 242.
[2] Amer. Jour. Med. Sci., 1907, cxxxiii, 88; Trans. Assoc. Amer. Phys., xxi, 155.

been only single attacks. Little help in the direction of solving the question of the etiology of the edema in the paroxysmal type of cases can be expected from mere tabulations of all the pathological conditions in which any sort of sudden pulmonary edema occurred; but in studying the detailed descriptions of the cases which have been reported and upon which the tables are based, the paroxysmal type stands out very prominently. Taking this group alone, it is found that practically all of the cases were instances of cardiac or renal disease, or arteriosclerosis. Young persons without any of these conditions may suffer infectious pulmonary edema, collateral edema, or edema following paracentesis; but the paroxysmal and recurring type has been found almost if not quite exclusively in association with the three conditions named.

So far as my own experience has been concerned, the cases have, with but one exception, been instances of cardiac, renal, or arterial disease attended with high blood pressure, and in the one exceptional case there was a cardiac lesion (mitral stenosis), and each attack of edema was preceded by a nervous disturbance which doubtless temporarily elevated the systemic blood pressure. In some of the reported cases of recurring pulmonary edema, unassociated with any of the three pathological conditions referred to, there have been other conditions—pregnancy (Riesman), nervous conditions (Levallée), Levy)—in which temporary or more continuous high pressure may have occurred.

The conditions which stand out most prominently in the cases that I have encountered have been increasing myocardial weakness and high arterial pressure. The occurrence of pulmonary edema has, therefore, been more common in cases of myocardial than of valvular disease, and in cardiac disease associated with nephritis and arteriosclerosis than in the absence of such an association. The possible significance of these facts may be left for further discussion until the data of experimental investigation have been detailed.

2. *Experimental and Physiological Data.* Professor Wm. H. Welch,[1] in 1878, published the results of some experimental studies

[1] Archiv f. path. Anat. und Phys., 1878, lxxii, 375.

which have thrown a great deal of light on the pathogenesis of sudden pulmonary edema. After reviewing various earlier theories he reports his experiments, which were directed to the determination of the possibility of producing pulmonary edema by obstructions to the outflow of blood from the pulmonary circulation. Some preliminary experiments showed that the adaptability of the heart and circulation is so great that ligation of several of the large branches of the aorta failed to interfere with the work of the left ventricle sufficiently to lower the systemic circulation notably or to occasion pulmonary congestion and edema. Ligation of the root of the aorta itself or clamping the pulmonary veins did occasion such results, but these procedures cause violent obstructions of the circulation such as have no analogies in ordinary disease. The crucial experiment, to which various less convincing ones led up, was one in which he was able to cause acute edema of the lungs in rabbits by squeezing the left ventricle between his finger and thumb, thus partially paralyzing it. He concluded that acute pulmonary edema is due to "a disproportion between the working power of the left ventricle and of the right ventricle of such a character that, the resistance remaining the same, the left heart is unable to expel in a unit of time the same quantity of blood as the right heart." He did not then deny the possibility of another explanation for collateral fluxion with edema or for infectious edemas, and in a recent statement (quoted by Meltzer, 1904) specifically admits that a larger proportion of the cases of pulmonary edema than is generally supposed is due to inflammatory changes in the vascular walls. His earlier experiments, however, conclusively demonstrated the fact that a lessened output of blood from the left ventricle, as compared with the right, could occasion acute pulmonary edema. It is of interest to note that in cases of marked interference with the systemic circulation, even involving the distribution of several of the large branches of the aorta, he did not obtain the same result, nor even a notable falling off in arterial pressure, a fact which can be explained only by the reserve power of the heart and the extraordinary capacity for adjustment of the vasomotor apparatus of the systemic circulation. This fact, I

believe, has important clinical bearings in connection with the cases of paroxysmal edema. It cannot be referred to any vasomotor adjustment in the pulmonary circulation, for the reason that the ligatures established mechanical obstructions in the peripheral circulation which, if not counteracted in the remaining peripheral circulatory pathways, must of necessity have caused eventual overfilling of the lungs despite any activity of the pulmonary vasomotors, if any such exist.

Sahli[1] criticised Welch's results adversely, giving two principal objections: (1) That in human cases of sudden edema the pulse does not indicate paralysis of the left ventricle, and (2) that the pathological condition of the lungs is not that of congestive edema. As to the first objection, Welch has pointed out that he had not claimed that complete paralysis of the left ventricle is necessary to the production of the result under consideration, and thinks that Sahli is in error in assuming that such a degree of paralysis is essential. A consideration of the physiological principles involved will easily prove the correctness of Welch's contention. Taking Tigerstedt's figures (and these are smaller than those given by other physiologists) for the average output at each systole of the right and left heart, 50 to 100 grams, and assuming that the left heart has lost one-twentieth of its working power, the result would be a retention in the left heart, and eventually in the pulmonary circulation of from 2.5 to 5 grams after each heart beat. In one minute, at a rate of 80 per minute, the amount of blood retained in the lungs would be from 200 to 400 grams. It is easy to see that the result must be a speedy overfilling of the lungs. That such a condition of affairs should take place in human disease presupposes that the vasomotor mechanisms of the peripheral circulation had for some reason become ineffective. A study of the cases in my series and others reported in the literature shows that there is good ground for believing that such an inefficiency of the vasomotor mechanism had become established.

In answer to Sahli's second objection that the anatomical con-

[1] Archiv f. exper. Path. und Pharm., 1885, 19.

ditions of the lungs are not those of congestive edema, Welch refers to his own microscopic studies in human cases which showed the existence of congestion, and notes that Sahli apparently relied on the pallid macroscopic appearance of the lungs, having seemingly made no microscopic examinations. Welch further states that microscopic examinations of lungs of pallid appearance often show marked hyperemia and diapedesis of red cells. I can confirm this statement from some recent studies of highly edematous but pallid lungs after adrenalin injections. While denying the force of Sahli's contention so far as the acceptability of Welch's theory is concerned, it may perhaps be true that the degree of edema in some cases of acute pulmonary edema of human beings is out of proportion to the degree of congestion. An increased permeability of the pulmonary vessels might perhaps be the explanation of a ready leakage of serum under conditions of but moderate overfilling of the pulmonary circulation. This point will be referred to later on.

Grossmann[1] and Löwit[2] also criticised Welch's conclusions, though there is no fundamental difference in the results of their experiments and Welch's. Grossmann caused pulmonary edema by poisoning with muscaria, and found the left ventricle in a state of spasm with resulting venous hyperemia of the lungs. He believes these conditions contrary to what Welch had stated in his conclusions, having overlooked the fact that disproportion in the working capacity of the left and right ventricle and not loss of power in the left ventricle was the important fact. Spasm of the left ventricle (though according to Welch unlikely in human cases) could, therefore, produce the same results as loss of ventricular power. Löwit's experiments seemed to him to show that increased flow of blood into the lungs as well as diminished outflow are two necessary conditions. If this were correct, there would be no conflict with Welch's postulates, but other experimenters did not find an increased flow into the lungs a necessary condition.

A study of the experiments of Welch, as well as of those who believed their results pointed to different conclusions, seems to show

[1] Ztschr. f. klin. Med., xii.

[2] Ziegler's Beiträge, xiv, 401.

without question that acute pulmonary edema may be caused by mechanical congestion of the lungs, the result of disproportionate work of the right and the left ventricles. It has been mentioned before that increased permeability of the pulmonary vessels may be a subsidiary cause, and two theories regarding the development of such a condition may be mentioned. According to some authors (Bouveret, Dieulefoy, Riesman), toxic agents acting in some obscure fashion, or through the vasomotor system, occasion in cases of nephritis rapid edema of the lungs somewhat in the same way as edema of the glottis occurs in the same disease. So far as the vasomotor system is concerned, it is important to observe that physiologists are practically unanimous in denying the existence of such a mechanism in the pulmonary circulation. If any exists, its range of action is extremely limited and is certainly too restricted to permit of its having more than a subsidiary place in the etiology of pulmonary congestion or edema. So far as the second possibility, that of some direct toxic increase of vascular permeability, is concerned, analogies drawn from studies of edema in other parts of the body make it probable that such a factor is of some importance. The fact that the lung is in a measure an excretory organ, and possibly liable to injury when vicarious excretion takes place, must be considered as having weight.

Hewlett[1] quotes his colleague Martin in confirmation of his belief that protein fluid of the concentration seen in one of his cases (total solids, 6.72 per cent., of which 6.302 per cent. was protein and 0.418 per cent. salts) could not have been forced through the vessel walls by any pressure short of one likely to cause actual rupture of the walls. However the facts may be as to this case, direct experiments have sufficiently demonstrated the possibility of edema mechanical in nature to the extent that any cause save the mechanical element was a negligible factor. This does not obviate the possibility that some injurious agent acting upon the vascular permeability may be a subsidiary factor in cases of spontaneous edema in man.

[1] Intercolonial Med. Jour. Australasia, 1908, viii, 611.

This is in conformity with Leber's[1] experiment, in which it was shown that the cornea with an intact epithelium of the membrane of Descemet will stand a pressure of 200 mm. of mercury, whereas once that epithelium is removed, solutions readily filter through. Very similarly, Tigerstedt and Santesson[2] found that the freshly removed lung of a frog killed with 0.6 per cent. NaCl solution will stand a pressure of 14 mm. of mercury for several hours without any escape of the contained fluid, whereas the same lung killed by slight heat or by pouring in distilled water, or frog's bile, at once allows filtration.

In view of these facts, it may be accepted as probable that some increase of vascular permeability may be a subsidiary cause in cases of recurring pulmonary edema, but it would seem unlikely that such a state of affairs could develop suddenly and as suddenly subside. A more reasonable view is that a temporary pulmonary engorgement acting in conjunction with an increased or established vascular permeability is the important cause.

The facts that have brought me to the conclusion that the mechanical element is predominant are the following: (1) Welch and others have demonstrated that sudden inadequacy of the left ventricle may in a purely mechanical fashion occasion acute pulmonary edema by causing pulmonary congestion; (2) cases of recurring edema have generally been cases in which there have been persistent high arterial pressure and increasing myocardial weakness; (3) the attacks are sudden in onset and usually of relatively short duration, following excitement in many instances and usually occurring at night; and (4) renal disease or other ascertainable sources of toxemia may be wanting in some cases.

The first of the points has been sufficiently discussed. As to the second, I wish to add that in the majority of cases under my own observation there has been a continuous high pressure, sometimes excessively high, and prior to the onset of the paroxysms of edema evidence of failure of the left ventricle. Among these evidences may be noted some increase in the size of the heart

[1] Archiv f. Ophthal., 1873, xix, 125.
[2] Bighang. till K. Svensk. Vet. Akad. Stockholme, 1886, xi, No. 2.

(dilatation) and weakening of the apex impulse and heart sounds, cardiac irritability indicated by extrasystoles, and oppression or anginoid attacks. Later, sometimes as a result of fatigue or excitement, an attack of acute edema of the lungs occurred, and following this repeated paroxysms at irregular intervals. In the cases in which excitement or effort preceded the attacks, there has been primarily a violent paroxysm of palpitation, then weaker action of the heart and edema of the lungs. This sequence of events was clearly distinguishable in several attacks I have witnessed. These events may be interpreted as indicating a sudden extra strain imposed upon a heart struggling for a long time against excessive peripheral pressure and deprived of the protection of an intact vasomotor mechanism. Sudden external stress in normal individuals is neutralized by the inherent reserve power of the ventricle and the capacity of the peripheral vasomotor mechanism to open the external vascular channels. In cases of long-standing high pressure, arterial disease, and myocardial weakness, the cardiac power is deficient and the vessels are incapable of prompt dilatation. Another explanation is possible in some cases, that is, that inadequacy of the coronary circulation may occasion sudden insufficiency of the heart muscle under physical strain or at times of naturally lowered cardiac power, as during sleep, without the coöperative effect of high pressure and failure of the peripheral vasomotor mechanism. Romberg[1] refers to such a condition of affairs in discussing attacks of cardiac asthma which he does not distinguish fundamentally from those of recurring pulmonary edema. It is unnecessary to enter very fully into the question of such a distinction here, but I wish to state my entire agreement with Romberg's view. It is impossible to draw a sharp line of demarcation between cases of cardiac asthma and those of acute pulmonary edema. Few of the former are unattended with edema of some degree, and none of the latter are free of dyspnea of the same type as occurs in typical cardiac asthma. The difference is one of degree only, and attacks of the two sorts may alternate in the same case.

[1] Krankheiten des Herzens, second edition, p. 82.

Regarding the symptoms and etiology of cardiac asthma, Romberg states: "The cause of asthmatic attacks is generally a sudden weakness of the left ventricle, which causes intense congestion of the lungs and thus leads to extreme dyspnea. The ventricular weakness is indicated also by marked rapidity, softness, and smallness of the pulse and frequently by irregularity and in the occasional development of dilatation of the heart. The congestion of the lungs is frequently followed by the exudation of edematous fluid into the alveoli. This pulmonary edema, which is indicated by small and large moist rales scattered over small or considerable areas of the lung, is a further occasion for dyspnea. The patient often coughs up edematous fluid, which may be light or dark red or even brownish, from admixture of blood, and may be of considerable amounts in some cases.

"The sudden loss of power in one of the sections of the heart may be occasioned by sudden embolic occlusion of one of the large branches of the coronary artery, but is practically only met with in cases of coronary sclerosis or in cases of widespread cardiosclerosis involving the distribution of blood to numerous capillaries, even though this interference be of but a moderate grade. One may, perhaps, conceive of the attacks as due to the following condition of affairs: When the power of the heart fails or when, as a consequence of overexertion or during rest, as in deep sleep, the tension in the coronary arteries falls below a certain point, the existence of sclerosis of the coronary vessels may occasion an inadequate supply of blood to the cardiac capillaries, as a result of which there must be great loss of muscular power."

While I cannot subscribe to this statement in all particulars, and especially to the view that attacks of cardiac asthma or acute pulmonary edema are in the great majority of cases due to coronary sclerosis or cardiosclerosis affecting the cardiac vessels, the effect of exertion, exhaustion, and deep sleep on cardiac power seems to me undoubtedly of prime importance in the determination of attacks of acute pulmonary edema in those predisposed to such paroxysms by long-existing high arterial tension and myocardial weakness. Romberg's statements, however, indicate another

possible source of such attacks in cases in which high peripheral tension has not necessarily been a predisposing factor.

In attempting to reach some conclusion as to the relative importance of toxic increase of permeability of the pulmonary blood-vessels and of mechanical engorgement of the lungs, resulting from deficiency of the left ventricle, I am especially impressed by the features of such cases as Case II of my series. In this case a woman with uncomplicated mitral stenosis and without evidences of renal disease has on a number of occasions during a period of ten or more years suffered attacks of sudden pulmonary edema, most of these attacks having followed some emotional excitement. There was never any acute illness before the seizure, and the recovery on all occasions has been so speedy and complete that within twelve hours all signs have vanished. The closest inquiry has failed to indicate even the possibility of a gastro-intestinal toxemia from dietary indiscretions. The mechanical element alone remains in evidence. One could, of course, conceive of vasomotor influences if there were sufficient grounds for believing that an active vasomotor mechanism is present in the pulmonary circulation. In other cases in which a renal lesion existed, and in which on this account toxic influences require greater consideration, the rapid onset and subsidence of the pulmonary edema are strongly opposed to the assumption that increased permeability of the vessels as a result of toxemia is a prime factor in determining the rapidly appearing and disappearing pulmonary lesion. On the other hand, a temporary weakening, under mechanical stress, excitement, or other influences, of the left ventricle, followed by restoration of equality of action of the two ventricles, could readily account for the event. The conclusion which I have reached is that the conditions outlined by Welch in his original paper are the important ones in cases of recurrent or paroxysmal edema of the lungs.

Treatment. The prompt effect of a hypodermic injection of morphine in cases of cardiac asthma led me to use the same remedy in one of the earliest cases of paroxysmal pulmonary edema that fell under my notice. The result was so striking that I have since pursued the same plan, and have found this so satisfactory that

it has never thus far been necessary to employ any other remedy except as an adjuvant. Some of the cases in the present series had large numbers of attacks, and eventually died, but there never was any difficulty in controlling the attacks themselves with morphine alone or supplemented with other less important drugs. When the fatal termination occurred, it usually resulted from gradually increasing failure of cardiac compensation, as in Case I. In some of my cases atropine was combined with the morphine in the hypodermic injections, but on repeated occasions morphine alone was used to test the matter, and was found quite as efficient as with the addition. Therapeutists have uniformly recommended atropine to cause a drying of edematous conditions of the lung, and the drug has, therefore, suggested itself, although it is difficult to appreciate in what manner such an effect could be brought about. When it was used independently of morphine, I found that its effects were not striking, as, for example, in one of the cases in this series in which large doses of atropine were administered during the first attack, and the duration of the seizure was eight hours. In a number of subsequent attacks of apparently equal severity, a single injection, or at most two injections, of morphine, with small amounts of atropine, sufficed to break up the seizures within an hour. In a few instances it seemed to me that the injections of morphine with the addition of small amounts of atropine acted more satisfactorily than injections of morphine alone, but I have come to the very positive conclusion that the atropine is of very secondary importance, notwithstanding the fact that in the discussion of Riesman's paper by the Association of American Physicians,[1] a number of those who took part spoke most favorably of this remedy, none, however, making any detailed reference to cases. The impression I gathered was that the remarks made were more or less offhand and based upon the traditional applicability of this drug.

Among the few authors who have mentioned morphine as a remedy for cases of paroxysmal edema, the most enthusiastic is

[1] Trans. Assoc. Amer. Phys., 1906, xxi, 170.

Hewlett, whose experiences coincide exactly with my own. In one of his cases he used morphine followed by atropine, but found that the latter had no noticeable effect. In eight remaining attacks in the same patient he used morphine alone, and found the patient invariably comfortable and out of danger in from one-half to three-quarters of an hour. In another of his cases, during his absence, a medical colleague was called in and employed various restorative measures with little effect. Upon Hewlett's arrival, three hours after the onset, he immediately injected $\frac{1}{4}$ grain of morphine, and within a half hour the patient was comfortable, quiet, and of good color.

The manner of action of morphine in these cases cannot perhaps be fully explained. There is undoubtedly in many of the patients an element of shock and mental disturbance which contributes to the severity of the symptoms and which may be mitigated by the infection of morphine. This view was expressed by Billings in the discussion of Riesman's paper. My experiences, however, in the treatment of many attacks in a number of patients leads me to doubt whether this explanation suffices for the very striking results obtained. If one may draw conclusions from cases of cardiac asthma, in which the results of injections of morphine, with or without atropine, are so well known, and in which an element of bronchial spasm seems to exist, one may perhaps suspect that, though it is not so apparent, a similar condition of muscular spasm is also present in the cases of pure edema, and that by relief of this, improvement is initiated. This might readily enough explain the cessation of active dyspnea, but could not so well explain the rapid disappearance of the edema itself. Having regard to the pathogenesis of paroxysmal pulmonary edema, and especially its probable dependence upon relative weakness of the left ventricle, the explanation of the value of morphine may be that it exercises a direct effect upon the heart itself, quieting and steadying it; and also may have a beneficial influence by quieting restlessness and relieving muscular spasm of the extremities which increase the flow of venous blood to the right heart and thus occasion a larger supply to the pulmonary circulation. It must be confessed, how-

ever, that no explanation that can be offered at present seems entirely adequate, and the value of the remedy must rest very largely upon clinical experience. A few experiments which I have made seem to confirm this. In these experiments I injected adrenalin solution into the ear vein of rabbits, causing pulmonary edema within a few minutes. In some of the animals, injections of morphine were made immediately after the adrenalin, and in others a similar injection of atropine was made following the adrenalin. In the cases in which morphine followed the adrenalin the onset of the edema was delayed and its intensity decidedly less, though the animals eventually developed edema and died. In the cases in which atropine was used there was an immediate onset of edema, which was much more decided than in the cases in which adrenalin alone was used.

Chloroform was used by Lissaman in his remarkable case in which seventy-two distinct attacks occurred. He found that he could control each of these in a very short time by inhalations of chloroform, finding that within ten to thirty minutes the patient became comfortable and was soon completely relieved. The effect of his treatment adds some confirmation to the opinion that the usefulness of morphine lies in its quieting effects. So far as the use of chloroform as a routine measure in such cases is concerned, it seems hardly likely that practitioners generally will be tempted to employ this remedy. The possible dangers of this drug in cardiac disease are too apparent to require further discussion.

Nitroglycerin has been frequently employed, and upon theoretical considerations may be regarded as indicated. If the pulmonary edema is the result of a partial or considerable failure of the left ventricle, vasodilatation under the influence of nitroglycerin would undoubtedly prove useful by rendering the residual ventricular power more efficacious. In cases of cardiac asthma with moderate pulmonary edema this result is not infrequently observed, but in the more serious cases of paroxysmal edema my experience has been that nitroglycerin and the nitrites generally fail entirely. Possibly the explanation hinted at before may explain this failure, viz., that paroxysmal edema occurs in cases of

persistent high pressure and arteriosclerosis in which the vasomotor mechanism has been exhausted to the extent that vasodilatation, under the influence of drugs or as a result of natural reflex agencies when stress is brought to bear upon the left ventricle, has ceased to be available.

Venesection has been highly lauded, and naturally suggests itself when one observes a case of severe edema with peripheral cyanosis. Merklen and Riesman advocate this plan of treatment above all others. Abstraction of blood from the venous system may undoubtedly relieve the pulmonary engorgement by diminishing the amount of blood flowing toward the right heart, and very probably it is in this manner that its usefulness is explainable. Compared to the simplicity of a hypodermic injection of morphine, venesection is a procedure of considerable gravity, and its effect cannot be more prompt or satisfactory.

After the first stage of the attack has been controlled by an injection of morphine and atropine, it is desirable to make use of cardiac stimulants to revive the power of the left ventricle and to promote vasodilatation, if this be possible. For these purposes injections of strychnine, digitalin, and nitroglycerin may be employed, and aromatic spirit of ammonia or brandy may be given by the mouth if the patient is able to swallow.

The after-treatment in cases in which one or more attacks have occurred consists in strict regulation of the daily life of the patient to avoid fatigue, excitement, cold, and physical strains, and some care of the diet, so as to prevent overloading of the stomach and superalimentation, particularly at the evening meal. Renal cases may require warm or hot baths and particular care of the diet, and when myocardial weakness is evident after attacks, moderate cardiac stimulation may with advantage be used more or less continuously. On account of its action on the coronary circulation and on the kidneys, caffeine is a drug that may be particularly useful at this time, but strophanthus, digitalis, or nitroglycerin may be desirable.

In some of the cases under my care who had the constant attendance of a nurse, I have left directions for (1) the immediate

administration of aromatic spirit of ammonia upon the first suggestion of an attack, to be followed by (2) an injection of morphine sulphate, $\frac{1}{4}$ grain, with atropine sulphate, $\frac{1}{250}$ grain, when the first definite symptoms appeared; and (3) the subsequent repetition of morphine and atropine after fifteen minutes, and later injections of strychnine and nitroglycerin. This plan served to control many threatening paroxysms before they had time to become severe.

DISCUSSION

Dr. David Riesman: I am glad that Dr. Stengel has brought this subject before the College, because it has not found adequate treatment in the text-books. The only edema mentioned by nearly all writers is the edema occurring in the course of failing heart and in the terminal stages of various other diseases. During the last two or three years attention has been given experimentally and clinically to the subject of edema in general and to that of the lungs in particular, but a definite solution to the many problems involved has not been reached. The acute edema of which Dr. Stengel has spoken is exceedingly interesting from the point of view both of etiology and of therapeutics. It is to my mind a distinct clinical entity, and, as I have elsewhere pointed out, in the suddenness of its onset and in the peril in which it places the patient it is comparable to angina pectoris. Dr. Stengel has referred to its occurrence in heart disease; I have also seen it in asthma, in arteriosclerosis, in pregnancy, and in Bright's disease. I would, and in this I must differ from Dr. Stengel, also place the sudden edema sometimes following tapping of the chest in the same category.

Regarding the cause of acute edema, I believe that the theory of Welch of disproportion in the vigor of the two ventricles is applicable in some cases, but does not explain all, and I am inclined to think that a vasomotor influence must play a part. I know that physiologists doubt the existence of a vasomotor mechanism in the lung, but the latest researches seem to show that such a mechanism exists, albeit it is a weak one. In a certain sense the acute edema of the lungs is comparable to angioneurosis of the skin.

Dr. Stengel speaks of the heart being weak during the attacks of edema. My own experience is different. I have nearly always found the heart strong and active in the apoplectic types of edema, and in several cases have been led by the high tension of the pulse to bleed. In one of my cases aphasia followed an attack of pulmonary edema, indicating that there had been serous exudation in the brain.

In the treatment of the acute edema I have found atropine a most valuable remedy; morphine is also indicated in that it lessens the great anxiety and fear

of death under which the patient labors. Another measure of great value is dry cupping; and I am in the habit of instructing some member of the patient's family in the use of the cups, as the attacks often occur at night and the physician may not always be reached quickly enough. In one of my patients, who has had sixteen attacks since January of last year, cupping and atropine together with inhalations of amyl nitrate have given most satisfactory results. One other point: It will usually be found that the rales in acute pulmonary edema are as marked at the apices as at the bases of the lungs, in this respect differing from the passive edema of failing heart.

Dr. John H. Musser: In my discussion of cardiac cases with my students I try to have them prepared to manage three emergencies—angina pectoris, pulmonary edema, and acute dilatation of the heart. In pulmonary edema the element of shock with pallor is a great feature, with the serious apprehension which Dr. Riesman has spoken of, and with a rather full pulse. On the other hand, there is cyanosis, the characteristic physical signs, and congestion of all the viscera in acute dilatation of the heart. Some years ago I attended a gentleman in attacks of this character, and in the last attack the excitement was so great that his wife overexerted herself, and three or four hours after the death of the husband I was called to see the wife with acute dilatation of the heart. There were marked differences in the symptoms of the two cases. One is interested to note that acute dilatation of the heart does not necessarily recur, but when attacks of pulmonary edema begin we are prepared to see them repeatedly.

As to the treatment, morphine has always been the remedy to which I at once resort, and it has always proved satisfactory. Like Dr. Riesman, I also cup.

Dr. S. W. Morton: Dr. H. C. Wood has called attention to the fact that pilocarpine has sometimes produced acute pulmonary edema. I have seen a case thus produced promptly relieved by dry cups. It has also been my fortune, during the past year, to see three cases of acute pulmonary edema. They happened in persons aged sixty, sixty-one, and sixty-eight years, respectively. Two had had evidences of general arteriosclerosis and cardiac asthma. The third had never any evidence of failing cardiac compensation. One had the acute pulmonary edemic attacks on three or four occasions. They usually came on in the night. On two occasions exertion seemed to produce them. As to the cause of these attacks, two of the patients had what seemed to be acute edema of the brain, in which there were hemiplegic symptoms which passed off within three or four days. There was hemianopsia in both of these. The third case had acute edema of the lungs, which was relieved by cupping and small doses of morphine. All were cases of chronic nephritis, and one developed, after two or three days, evidences of what seemed to be true hemorrhage into the brain.

Dr. W. S. Wadsworth: This condition is one which I have to study very frequently. For the past ten years I have averaged more than twenty cases a year, and these with other forms of edema and with simple or complicated congestion form one of the largest groups of cases I see. For this reason I venture to point out a few things that I have determined from this large experience.

This condition occurs very commonly in injuries to the brain by mechanical violence; it also occurs in conditions where the central nervous system is poisoned, as in opium and carbon monoxide poisoning. It is found in certain cases where shock has been pronounced, and may be found in drowning where no water has entered the trachea, owing to spasm.

When the kidneys fail to eliminate properly and there appears a toxic condition of the nervous system, it may be expected. Also when mental symptoms develop suddenly in heart disease, either from change of brain circulation or when both heart and brain symptoms are directly due to condition of blood, it is very apt to occur. From this it may be seen how large a part the nervous system plays in these cases. My belief is that it plays the largest part in most of the cases as a direct cause.

No attempt to explain the etiology of the condition can be satisfactory without a full recognition of the part played by the central nervous system.

Dr. Stengel (closes): The important matter that I had in mind to bring here in regard to these cases was the usefulness of morphine in the treatment of cardiac cases. I believe some of these cases perish because physicians are afraid of morphine.

As to the etiology, Dr. Riesman will find that I have gone into that in the full paper and have included the vasomotor theory.

A METABOLIC STUDY OF MYOTONIA ATROPHICA[1]

WITH THE REPORT OF TWO CASES

By RALPH PEMBERTON, M.S., M.D.

INSTRUCTOR IN MEDICINE IN THE UNIVERSITY OF PENNSYLVANIA; PHYSICIAN TO THE OUT-PATIENT DEPARTMENT OF THE PRESBYTERIAN HOSPITAL, PHILADELPHIA

(From the William Pepper Laboratory of Clinical Medicine and the Presbyterian Hospital of Philadelphia)

The case which forms the basis of the following considerations is interesting in several connections: (1) Because it represents a rare clinical entity; (2) because it showed in the light of metabolic study some findings more marked than is customary in analogous conditions; (3) because one of the findings is now reported for the first time in connection with the disease; and (4) because such metabolic observations seem to throw light on the classification of the condition and suggest a means of arriving at a true diagnosis in obscure diseases of this nature.

A. B., aged thirty-seven years, white, female, married

Chief Complaint. Stiffness in the shoulder, elbow, and knee; pain in the back and difficulty in walking

Family History. Negative, except that the patient is fairly confident that a sister who died in childbirth had an involvement of the hands similar to hers, but was otherwise healthy.

Social History. She menstruated at the age of fourteen years, has been regular ever since, and was married at the age of twenty years. She has three children living, two of them healthy, and has had one miscarriage; one child died at birth with convulsions. A boy, aged about ten years, has hydrocephalus and is in a school for feeble-minded children. The patient states that he has some similar difficulty on opening his hands after tightly closing them,

[1] Read December 7, 1910.

but this did not appear when he was examined. She does housework and formerly drank a small quantity of beer at intervals, but has had none for ten months; takes coffee and tea once daily.

Medical History. She had measles and pertussis when a child, and diphtheria twelve years ago. She has never been ill in bed except for confinements, and was well until the onset of the present trouble seven years ago.

Present Illness. Seven years ago she noticed a weakness in her knees which prevented her from going up stairs readily, although she otherwise felt well. With the aid of a little support she could manage easily and had no difficulty in walking on the level. The weakness in her legs became slightly more marked, and one year later, after a childbirth, she developed a dull, aching pain in the back. This pain has persisted on and off up to the present time. The weakness of her legs slowly increased so that four years ago she began to place her hands on her knees when she wanted to rise from a sitting posture. Three months ago she noticed some weakness in her left arm and shoulder which prevented her raising her arm over the back of her head and caused her to lean forward to comb her hair. This last development she thinks came on rather suddenly; she says she went to bed well one night and got up the next day weak, as described. She says that long before the onset of her attack she had difficulty in opening her hand after closing it tightly. When she presses her tongue against her front teeth she cannot for a few seconds protrude it or talk. This condition she says is of recent development (a matter of a few months), though she does not know exactly how long. Her bowels have been a little loose, but she has had no difficulty in urination.

Physical Examination. This shows a rather adipose woman of large build, prominent forehead, and good intelligence (Fig. 1). There is marked prominence of the seventh cervical vertebra posteriorly and the back, as a whole, is round. The tongue shows a slight moist fur and is easily and evenly protruded except as above described. The eyes give normal motions and reactions, except that the eyelids can be opened with ease against the resistance of the patient. Dentition is poor and teeth are poorly cared for.

Fig. 1.—Photograph of the patient, showing the suggestion of ptosis from weakness of the levatores palpebrarum.

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Figs. 2, 3, 4, and 5.—The pictures of the patient's hand show the successive positions assumed in the attempt to open it after forcible closure.

The radial pulse is regular and of good volume, rate, and tension; the cardiac outline is normal and the sounds are good, without murmur. The lungs are apparently normal. The liver extends from the fifth rib to the costal margin. The abdomen is large and relaxed, showing numerous striæ, but otherwise is negative.

Reflexes and Musculature. The eyelids can be easily opened against the patient's resistance as mentioned, but the control of the muscles of expression is good, and there is no asymmetry of the face. No weakness of the temporals or masseters can be developed and the mouth can be drawn equally to either side, but when she is told to smile, the angles are not much retracted. The head is held markedly forward during the acts of sitting down or getting up. The neck is rather plump and there is a very slight swelling of the thyroid which, according to the patient, has existed in its present state for years. The sternocleidomastoids cannot be clearly felt and turning the head in various positions does not make them conspicuous. The scapulæ are both prominent on the inner edges, especially the left scapula, which protrudes markedly when the left arm and shoulder are moved. There is some evident wasting of the associated muscles, especially visible on the inner side of the scapula, but adiposity masks its exact distribution. Anteriorly the chest seems flat in the upper part and the pectorals seem less developed than normally. There is no evident wasting in the deltoid, arm, or forearm region. The biceps and triceps reflexes are greatly diminished or absent. The patient has diminished but moderate strength in both arms (for acts not involving the shoulder girdle), but the shoulder muscles on the left are so weak that the left arm cannot be actively raised high enough to place her hand on her head. Passive movement of all limbs, however, is everywhere free. The hands are well formed and the fingers rather tapering. The power of contraction of both hands is below par and when closed as firmly as possible there occurs, for a few seconds, an inability to open the hands again (Figs. 2, 3, 4 and 5). When opening them, the fore and middle fingers are extended first, followed by the third and fourth in a slow athetoid manner, after which the thumb is extended and then finally the whole hand and palm are opened flat,

Sometimes the third and fourth fingers are opened first, but the general movement is always the same. There is also a tendency for the thumbs to be held adducted across the hands.

The power in each leg is everywhere below normal. The left is larger than the right and has been so, she says, since the birth of her last child, when she had "milk leg." It is not œdematous. The right seems to be slightly less than normal in size below the knee, there is relatively little calf for the general build of the limb, and the muscles of the calf seem rather soft and flabby on palpation. The thighs seem smaller than they should be, and there is, possibly, some flattening of the vasti externi. The left leg below the knee is, perhaps, slightly firmer to palpation than the right, but the patient feels that the power in each is about equal. The buttocks seem to be less protuberant than in health, but the gluteal crease is equal on each side and adiposity masks the true condition of the muscles here. On rising from a sitting posture, the patient places her hands on her knees to obtain greater support. In getting up from the floor she rises on one knee, then gets on all-fours, finally puts out one leg and by the support of a hand on a chair, for example, rises. She cannot get up without this external aid. In walking the alignment of the feet is rather poor, though not incoordinate. The patellar jerks are diminished, though present, and there is neither Babinski's sign nor ankle clonus.

Urine. Acid, with a granular sediment, a few white blood corpuscles, and some epithelium.

On October 27 the systolic blood pressure was 96 mm. Hg. and the diastolic 65.

On October 29 the eye fundus showed no change, though there was beginning opacity of both lenses.

The leukocyte count was never higher than 8650 and the differential count was normal. Hemoglobin, 88 per cent.

The patient stated (April 28, 1910) that in swallowing she sometimes has some difficulty, which is of fairly recent development.

On April 28, 1910, the electrical reactions were tested by Dr. J. W. McConnell and found to show some diminution of response, about equal everywhere, but there was no indication of the reactions of degeneration.

Weight on October 14, 1909, 153 pounds (69.54 kilos).

Weight on October 22, 1909, 157 pounds.

The patient is a sufferer from psoriasis, which is worse in summer. On August 23, 1910, about ten weeks since last previous examination and about ten months since she first presented herself, she said she felt that she was slowly growing worse and had recently developed some unsteadiness of station which she thought was not due to weakness. She complained of some slight difficulty in swallowing. On examination, her pupillary reactions were found as before and her station with the eyes shut was good. On rising, however, or on stopping suddenly when walking, she would, at times, show the above unsteadiness. She also complained of increasing difficulty in performing her work. The thenar and hypothenar showed some suggestion of atrophy, though it was not marked.

Subsequently to the completion of the metabolic studies upon the present case, here to be reported, I had the opportunity to examine another instance of the same condition. It occurred at the Philadelphia General Hospital in the service of Dr. D. J. McCarthy, who has very kindly given me permission to include it in the present paper. For this courtesy, I wish to express my appreciation.

Social and Medical History. The patient is a white male, aged forty-two years, formerly married, but only for a few months, when he left his wife for infidelity. He had no children. His family history is negative for any analogous condition, though one brother now has phthisis and one sister cannot talk loud; possibly as the result of diphtheria and some operation connected with it. The patient's birth was normal, and he was the fifth member of the family. He says that he had repeated attacks of diarrhœa until two years of age, when he developed "St. Vitus' dance." At intervals of two years afterward, and until he was twenty-six years old, he had recurrent attacks of it, for which he took Fowler's solution, up to thirteen minims three times a day, which always relieved him. Otherwise, he says, he always felt well, except that at the age of sixteen years he had "bronchitis," which confined him to bed for a month. At one time he injured his eyes on a bet by looking at the

sun for five minutes at 3 o'clock of a bright afternoon. This wager resulted in blindness, which lasted three weeks, since when he has worn glasses. He says that from fourteen to nineteen years of age he was subject to headaches, which were relieved for five years by the removal of a nasal polyp, but they then recurred, and he now has a slight frontal headache much of the time. His voice is somewhat nasal. He denies all venereal history.

Present Illness. The onset of his present trouble dates back seventeen years, when he was a nurse in a large hospital. A fall called his attention to the fact that his feet flopped in walking and that his legs seemed weak. His knees soon became affected, causing him to fall more frequently, and his progress from that time has been steadily worse. Ten years ago he first developed some symptoms of Thomsen's disease, seven years after the weakness in his legs began, and now experiences frequently a "locking" of the limbs when he rises from sitting or begins almost any act involving the arms or legs.

Physical Examination. Examination shows a well-nourished and intelligent man of 5 ft. 7 in. He is "pot-bellied" from accentuation of the dorsolumbar curve. The facial expression is intelligent and tranquil. The extraocular movements are apparently normal, though there may be some slight weakness of convergence. The pupils are equal and react well to accommodation, but sluggishly to light. There is some ptosis when the patient looks before him. The orbiculares and levatores palpebrarum are markedly weak and there is twitching of fasciculi of the orbicularis palpebrarum on the left, which, he says, has been present for seven years. There is slight weakness of the buccinators, but not of the orbicularis oris. The tongue is protruded evenly and easily in midline, and is clean, without fissure, atrophy, or tremor. The sternocleidomastoids are greatly atrophied, and when the head is put back it cannot be brought forward without great effort. There is free passive and active motion of both arms and coördination is good.

There is no atrophy of the subscapular group on either side, but both supraspinati show some atrophy, especially on the left. The left deltoid shows marked atrophy, but the right apparently

shows none. There is slight atrophy of the biceps and triceps on the left, and a very little on the right. There is considerable loss of extensor power on the right. Flexor power of the right arm is good, of the left moderate. There is moderate atrophy of both forearms, especially of the ulnar flexor group, and the grip is reduced 50 per cent. Both thenar and hypothenar eminences show slight atrophy, and it is moderate in all the interosei. The triceps reflexes are present on both sides on reinforcement, but the biceps can be obtained only on the right.

The legs everywhere show wasting, though the right is slightly larger than the left. There is a corresponding and moderate loss of power in both legs. The knees are both hypotonic and the knee-caps protrude anteriorly. The vasti externi share in the general wasting and probably suffer slightly, though not markedly, more than the rest of the leg muscles. The flexors of the foot show weakness. There is no knee jerk, ankle clonus, or Babinski sign, and there is no tenderness over the nerve trunks. The toes flex to plantar irritation.

The station with the eyes open or shut is good, though there is some instability because of weakness in the legs. There is a steppage gait. The hands show the myotonic feature of inability to relax for a few seconds after forcible closure and finally relax in a slow athetoid manner. The legs "lock," that is, become fixed in position when he starts to walk, as do the arms also for certain acts, and when the legs are affected his whole body remains apparently motionless for an instant. When the limbs are locked, the muscles concerned are contracted.

The intrathoracic and intra-abdominal organs present no important abnormalities, though both testes show atrophy, especially the left. The patient has no sexual desire and erections are involuntary. He cannot retain his urine as long as normally.

A review of the bibliography reveals the fact that but one report of this interesting condition has been made in American literature, so far as the author can ascertain,[1] although in all a total of twenty-

[1] Ramsay Hunt, Myotonia Atrophica, Jour. Nervous and Mental Disease, 1908, xxxv, 269.

five cases have been reported by foreign observers. In 1897 Pelizaeus called attention to a case evidencing the phenomenon of Thomsen's disease (myotonia congenita) with symptoms of muscular atrophy, and another instance was reported in 1899 by Nogues and Sirol. In 1900 Hoffman contributed a study which showed that muscular atrophy occurs in approximately 9 per cent. of cases of Thomsen's disease, since when there has appeared a number of articles recording the association of muscular atrophy with manifestations of Thomsen's disease and sometimes of myasthenia. Probably the most complete exposition is contained in a monograph by Batten and Gibb.[1] Various names have been applied to this syndrome, the present nomenclature of which is redundant and confusing to the student. Rossolimo first used the term "myotonia atrophica" because it serves shortly to describe the salient features, but this bears an unfortunate resemblance in sound to myotonia congenita (Thomsen's disease), and to myatonia congenita or amyotonia congenita. Other terms employed have been "myotonia with muscular atrophy" (Lannois), "muscular atrophy with the electrical reactions of Thomsen's disease" (Lortat-Jacob and Thaon), "Thomsen's disease with muscular atrophy" (Nogues and Sirol), "Atypical forms of Thomsen's disease" (Pelz), "Muscular atrophy with slow relaxation of muscles" (Kleist), but myotonia atrophica is that most frequently applied. The term "myotonia" is objected to by some, since it is occasionally used as synonymous with Thomsen's disease, and, similarly, the use of the adjective "atrophica" has found disfavor because the order of events is not always as the title suggests, that of dystrophy followed by atrophy and also because the atrophy may not occur in the muscles affected. It is not the purpose of this article to consider at length, as has been well done elsewhere, the clinical features and variations of this disease, but the rarity of the condition demands, perhaps, a few words of exposition as to the leading characteristics.

There seems to be a familial tendency in regard to its occurrence, as might be expected in view of the hereditary nature of Thomsen's

[1] Brain, 1909, xxxii, 187.

disease, but the etiology is at present quite obscure. The disease more commonly affects males between twenty and thirty, and the myotonic feature usually precedes the atrophy, though, as above indicated, this order is by no means constant. The sex of the first case here reported is interesting, since the few recorded cases leave no doubt that the disease is commoner among males. In only 3 out of 20 cases were the patients women, and in 2 of these the symptoms were so slight as to have escaped observation until it was attracted by the presence of the affection in a more marked degree in other members of the family. The condition begins insidiously, with or without a previous history of myotonic symptoms and with varying degrees of incapacity. When the case has developed, examination reveals muscular atrophy in the face, especially in the orbicularis palpebrarum and orbicularis oris, with occasional involvement of the mandibular group or the sterno-cleidomastoids. Of the upper extremities the forearm may be wasted, but the hand muscles are usually well preserved. The vasti of the thigh generally show atrophy, as do sometimes the peroneal and anterior tibial group, but elsewhere in the body the musculature escapes, except for a rare affection of the laryngeal. That the distribution of the atrophy may vary is well illustrated by the case of Steinert's that came to autopsy in which, contrary to the usual distribution, the hands and general musculature of the body were involved. According to Batten and Gibb, the muscles of the shoulder and upper arm are rarely affected, but in a few cases there has been noticed a wasting of the supraspinati and infraspinati. The myotonic symptoms are usually not widespread and are generally best or solely exhibited in the grasp of the hand. Flexion of the fingers and hand around an object is usually well performed, but on attempting to relax, a considerable interval must elapse before the hand can be straightened out; and even then this may be accomplished by a somewhat athetoid contortion. The greater the force of the grasp, the greater the difficulty of undoing it, though, after repeating the act a few times, it is finally easily accomplished. The difficulty of relaxation is not due to weakness of the extensors. The tongue may occasionally show

involvement, and there have been recorded instances in which this disability affected the upper arm and neck, but the legs are usually but slightly implicated. There are also instances in which perfectly typical cases of myotonia congenita have been affected with muscular dystrophy (Steinert), but in these the myotonia preceded the atrophy, had existed from childhood, and was widely distributed. Collins[1] has described a curious condition in which there were present extensive myotonic symptoms, on purposive movements, which affected the whole body and were accompanied by some hypertrophy. The myotonia, however, tended to increase as long as the movements were kept up and there was no atrophy, no myotonic reaction, or familial history. There also seemed to be some evidence of hysteria.

The electrical reactions in the disease under consideration show a diminution of irritability to the faradic current, but nothing more. The pathology of the disease is confined to the study of one or two cases by Rossolimo and Steinert, the latter of whom has recently made a complete examination and has shown that the condition of the muscles is the same as in other myopathic cases. He found, however, degeneration of the posterior column in the lumbar region which could be traced up into the cervical, but he regards the cord condition as purely incidental. He agrees with Hoffman that these cases are true instances of Thomsen's disease and sums up his conclusions as follows: "The so-called 'myotonia atrophica' is a condition in which a typical case of Thomsen's disease is affected with muscular dystrophy. The clinical feature of this atrophy is sharply defined and highly characteristic. It occurs only in this form in Thomsen's disease. The comparative frequency of impotence and atrophy of the testicle should be emphasized." More recently a suggestive case in a female, aged thirty-four years, has been reported by Steinert in which the symptoms of the menopause had occurred. Sometimes the myotonic features are late in appearing and occasionally the myotonia has followed the myopathy. Batten is inclined to place

[1] Postgraduate, New York, 1905, xx, 516, 519.

these cases in the great group of myopathies, but in his own words, further clinical and pathological experience is required before any definite statement can be made.

It will be seen from a consideration of the above that the present cases can be best categoried by inclusion in the group designated myotonia atrophica, and I wish to express my obligation to Dr. William G. Spiller for helping me to a diagnosis and for emphasizing the neurological interest involved.

When the first patient presented herself at the dispensary for treatment, it seemed that observations on the general metabolism, creatinin, and calcium in particular, would be of interest and might help to classify the condition, especially in view of the results of some similar investigations conducted recently on a case of myasthenia gravis.[1]

In this last instance a rather low creatinin output was observed together with a very marked loss of calcium. A low creatinin output in myasthenia has been noted by Spriggs, though not so low as in the case referred to, but the calcium determinations just recorded were then made for the first time in this condition and were of considerable interest. The loss of calcium in seven days amounted to over 9 grams, and after the administration of this element for over two years by Dr. William G. Spiller, under whose care the patient was, recovery was practically complete and the patient now feels himself well. A consideration of this and of the other close relations which have been shown to exist between calcium and various muscular phenomena, emphasized the advisability of extending the observation to other muscular aberrations.

As far as I am aware no metabolic study of the calcium metabolism is on record in regard to either muscular dystrophy or Thomsen's disease, and the present case seemed a fitting one in which to attempt such a determination. Indeed, no attempt has been made to approach the question from any standpoint other than the clinical, beyond the suggestion made some years ago that veratrum poisoning in frogs caused somewhat similar

[1] Pemberton, A Study of the Metabolism of Myasthenic Gravis, with a Suggestion Regarding Treatment, Amer. Jour. Med. Sci., 1910, cxix, 816.

phenomena on electrical stimulation, and that the condition might be referable to some metabolic disturbance. After a day or two of observation in the dispensary the patient was admitted October 7, 1910, for the purpose of diagnostic and metabolic study to the service of Dr. Joseph Sailer, at the Presbyterian Hospital, to whom appreciative acknowledgment is due for the privilege of undertaking and reporting the work upon her when in the ward.

She was placed upon a generous weighed diet, which was adapted to suit her particular demands, and analyses were made over a period of five days on the urinary nitrogen, creatinin, and calcium and the fecal nitrogen and calcium. The patient had been living under circumstances of rather poor hygiene, had been worried about herself, and had been expending much effort in the care of her home. When she was put at rest in bed in the hospital, the physical quiet and generally favorable conditions reduced the strain from which she had suffered and improved her spirits and stimulated her appetite. The results were that she gained two pounds in five days and showed a nitrogen retention of 28 grams. In this same period the calcium metabolism presented almost a balance showing a trifling loss of 0.5668 gram.

The creatinin output in the case now under consideration was found to average 0.40278 gram per diem, which gives the creatinin nitrogen expressed in terms of total urinary nitrogen as 1.77 per cent.

In a series of cases of various perversions of muscular function, including dystrophy, Spriggs[1] observed an output of creatinin ranging from 0.5 gram to 3 grams, but in none recorded was it so low as 0.40278. In myasthenia gravis (my case[2]) the creatinin output was 0.39155. Spriggs' adult case of dystrophy gave a daily average of 0.53 gram, which is, however, a creatinin percentage as above of 1.7.

It has been found useful by observers generally to express the daily creatinin elimination in milligrams of creatinin per kilo of body weight, and this ratio is called the creatinin co-efficient. In

[1] Quarterly Journal of Medicine, 1907, i, 63.
[2] Amer. Jour. Med. Sci., 1910, cxl, 256.

health it varies from 7 to 11 milligrams of creatinin nitrogen In Spriggs' series he found the lowest co-efficient in the dystrophy cases which gave 2.2 and 4 milligrams respectively. The former of these was in a boy of only fifteen and three-quarter years.

Levene and Kristellar[1] have also observed very low creatinin co-efficients; and one adult, aged twenty-one years, in their series of five cases of muscular dystrophy gave a co-efficient of only 0.7, but observations were made over a period of two days only, and such an extremely low result is very exceptional. The other adults in their series averaged 3.16. Similarly other observers have recorded low results in dystrophy and in a number of pathological conditions, and Myers has found a co-efficient of 2 in two very discrepit old women studied by him. This is a very low figure, however, for adults, and the case now being reported is noteworthy in that the creatinin co-efficient was 2.0139.

This was not suggested, *a priori*, by the condition or the general activity of the patient, who is able to care for her own home and a family of five. While there was plainly atrophy of tissue in the scapular region, it did not seem excessive, and was further masked by the general adiposity. There was no pseudohypertrophy. A consideration of these results was an aid in classifying the disease from which the patient suffered, and indicated more strongly than could clinical observations alone its probable nature as well as the degree of involvement. It was possible to eliminate myasthenia gravis with relative ease, although in the past myotonia atrophica has been so diagnosticated; but had there been more doubt as to this, a consideration of the calcium balance would have thrown weight in the same direction. This last needs corroboration by studies of other cases, but it is cited to indicate the use to which could be put the slowly increasing number of metabolic observations in these states, and the importance of studying such doubtful affections from a dynamic point of view.

More complete observations on the creatinin and calcium metabolism in dystrophy and several muscular perversions of function are now being made.

[1] Amer. Jour. Phys., xxiv, 45.

Conclusions. As far as the study of one case can be relied upon it may be said that there is apparently no significant disturbance of the calcium output in muscular dystrophy; at least, in the presence of those phenomena which suggest Thomsen's disease. This can probably be also inferred, though not surely, in regard to Thomsen's disease *per se*. The creatinin output, however, under these circumstances may be considerably reduced and the creatinin co-efficient conspicuously low. A consideration of the calcium, creatinin, and general nitrogenous metabolism as recorded here, and in myasthenia gravis, may lead to information of value in classifying doubtful conditions of this nature and localizing the perversions of function. It seems that such investigations should be more frequently undertaken in careful clinical studies.

Finally, I desire to express, with appreciation, my indebtedness to Dr. James E. Talley for many courtesies shown me in the wards of the Presbyterian Hospital.

Diet

Oct. 13	Eggs.	Bread	Milk.	Rice.	Butter.
B	88	62	12		
D	84	70	12	65.1	55
S	85	51	12		
Oct. 14					
B	89	90	12		
D	91	70	12	57.2	99
S	89	65	12		
Oct. 15					
B	89.75	72	12		
D	85.	80	12	63.9	32
S	89.50	67	12		
Oct. 16					
B	72	79	12		
D	96	72	12	69.7	89
S	84	76	12		
Oct. 17					
B	112	78.5	12		
D	97.50	80	12	51.6	60
S	109	27.5	12		
Total . .	1360.75	1040.0	180	307.50	335

Percentage Contents of Foodstuffs in Ca and N.

	Per cent. calcium oxide.	Per cent. nitrogen.
Eggs	0.122	2.008
Bread	0.041	1.265
Milk	0.184	0.574 (1031 sp. gr.)
Rice	0.0145	1.110
Butter	0.030	0.080

Total Food Ingested

		Grams.
Eggs	Calcium	1.1771
	Nitrogen	27.1231
Bread	Calcium	0.3045
	Nitrogen	13.1560
Milk	Calcium	7.8049
	Nitrogen	34.0873
Rice	Calcium	0.0445
	Nitrogen	3.4143
Butter	Calcium	0.1073
	Nitrogen	0.2680

Urinary Figures for Each Day

		Grams.
Oct. 14	590 c.c.	
	Creatinin	0.300
	Ca	0.1257
	N	6.720
Oct. 15	800 c.c.	
	Creatinin	0.386
	Ca	1907
	N	8.6240
Oct. 16	410 c.c.	
	Creatinin	0.2695
	Ca	0.1508
	N	4.6592
Oct. 17	1100 c.c.	
	Creatinin	0.5742
	Ca	0.2392
	N	12.0102
Oct. 18	1075 c.c.	
	Creatinin	0.4842
	Ca	0.2608
	N	10.2256

Urinary Totals

Creatinin	2.0139
Calcium	0.9672
Nitrogen	42.2390
Ca in total feces	9.0047
N in total feces	7.5413
Total ingested calcium	9.4041
Total excreted calcium	9.9719
Negative calcium balance	0.5668
Total ingested nitrogen	78.0476
Total excreted nitrogen	49.7821
Positive nitrogen balance	28.2655
Daily average of creatinin excreted	0.40278
Total creatinin excreted	2.0139

Creatinin co-efficient = milligrams of creatinin (daily) nitrogen per kilo of body weight = (normally) 7 to 11 milligrams.

Present ratio	0.149713	0.002138
	69.54	

The creatinin co-efficient in the present case is, therefore, 2.138 milligrams. The figures for the creatinin co-efficient are made up on the lowest body weight; they would be even less if made up on the average body weight or on the greatest body weight attained during the experiment. The percentage contents of the foodstuffs in Ca and N was taken from "A Study of the Metabolism of Acromegaly."[1]

BIBLIOGRAPHY

Batten. Lancet, 1909, ii, 1486.
Batten. Quarterly Jour. Med., April, 1910.
Batten and Gibb. Brain, 1909, xxxii, 187; ibid., 1906, xxix, 414.
Buzzard. Proc. Roy. Soc. Med., 1908, Neurol. Section, p. 33.
Curschmann. Münch. med. Woch., 1906, p. 1281.
Fox. Proc. Roy. Soc. Med., Laryngological Section, 1908, p. 107.
Frohmann. Deut. med. Woch., 1900, 6.
Furnrohr. Deut. Zeit. für Nervenheilkunde, 1907, xxxiii, 25.
Hoffman. Ibid., 1900, xviii, 198. Neurol. Centralb., 1905, 576.
Hunt. Jour. Nervous and Mental Diseases, 1908, xxxv, 269.
Kleist. Jour. f. Psychol. und Neurol., 1908, x, 95.
Lannois. Nouv. Iconogr. de la Salp., 1904, p. 450.
Lortat-Jacob and Thaon. Arch. de neurol., 1905, xx, 32.
Nogues and Sirol. Nouv. Iconogr. de la Salp., 1899, xii, p. 15.
Nonne. Neurol. Centralb., 1905, p. 142.
Passler. Neurol. Centralb., 1906, p. 1064.
Pelz. Arch. f. Psych. u. Nervenkrank., 1907, xlii, 704.
Rossolimo. Nouv. Iconogr. de la Sal., 1902, xv, 63.
Schlisinger. Neurol. Centralb., 1902, xxl, 84.
Siemerling. Münch. med. Woch., 1905, lii, 1072.
Steinert. Deut. Zeit. f. Nervenheil., 1909, xxxvii, 58; ibid., 1910, xxxix, 1, 2.

DISCUSSION

Dr. Alonzo Taylor: I desire to express my appreciation of the courtesy of the Committee in asking me to speak upon this subject. The courtesy, however, implies a confidence which I feel to be wholly misplaced, for it has never been my privilege to see one of these cases. I believe, however, that Dr. Pemberton has struck the only line that could be attacked with a prospect of successful solution, in suggesting that the muscular system is concerned in the production of myotonia atrophica. While the muscular system is a system of locomotion, it is also an immense organism of metabolism. The observation of a low creatin output means not necessarily that the total weight of the muscles is reduced, but that its metabolic co-efficient is reduced. The large portion of the creatin output originates in the muscular system, and in this alone is found a diagnostic criterion of the disease which will aid in its clinical

[1] Edsall and Miller, Univ. Penna. Med. Bull., xvi, 143.

diagnosis. I am not surprised to learn that there was no deflection in the calcium metabolism. This could not have the same meaning or the same import as a disturbance of creatin metabolism.

Dr. David L. Edsall: I have been very much interested in this work of Dr. Pemberton, and in the work that he has previously done on closely related subjects, because it has appeared to me for some years past that it is extremely desirable to get an accumulation of facts in regard to metabolic disturbances in nervous diseases, and particularly in relation also to the muscular system. As Dr. Taylor has just said, we are very prone to think of the muscular system chiefly or entirely as a locomotor system, while at the same time we know that profoundly important metabolic functions go on in the muscles, and clinical observation alone is sufficient to show the vast importance of muscular activity in maintaining normal functions. I have in the last few years made a series of studies of metabolic conditions in a variety of disorders in which there is clearly, or probably, marked muscular disturbance, and in other conditions in which the muscles themselves are not primarily affected, but they are secondarily involved in nervous disturbances. Most of these studies are not yet published. They include epilepsy, family periodic palsy, the cases that I have recently described that have violent spasms due to exposure to high temperature, and other conditions, and particularly a number of varied types of what is commonly classed under the heading of neurasthenia. I believe from the results that I have so far obtained that very possibly through a study of calcium, and perhaps magnesium metabolism, and more probably through a study of the creatinin, we may be able to make a more broad and rational classification clinically of many of these cases, shall perhaps be able to recognize them more clearly, and, not improbably, may have more direct methods of treating some of them in the course of a reasonable time. At present it appears to me that in certain types of cases calcium metabolism appears to be distinctly disturbed, and in some instances there is indication that the administration of calcium has actually done good. How far this will prove to be of any importance I cannot now determine.

Dr. D. J. McCarthy: From a statistical standpoint the record of twenty-nine cases reported from the literature, with one in American literature, is somewhat misleading. The tendency to report cases is much more common in Germany than in this country. I have had knowledge of three cases—one case referred to tonight by Dr. Pemberton, a case seen with Dr. Carncross, and another case I have had in private practice. The condition to my mind is not such an infrequent one.

The physiological chemists take the attitude that the muscular system has other functions than purely motor, as if it were something new; but if they will make a careful study of the treatment of nervous diseases they will find that in our country neurologists consider that the muscles have a very definite

chemical function in the body. This is somewhat ill defined, but it is a function that has been taken into account in association with the treatment. There is no question at all, I think, if one studies cases of neurasthenia, with flabby muscles and with very marked derangement of metabolism, of evidence that derangement of muscle metabolism plays an important part. Attention must be paid to the muscles in the application of massage, electricity, and hydrotherapy. The good influence of hydrotherapy in the functional nervous disorders is due as much to the influence upon the muscular system of the force of water, a massage effect, as to its effect on the circulation, which indirectly affects the muscle metabolism.

Dr. William G. Spiller: The man with myasthenia gravis, to whom Dr. Edsall referred, was a patient of mine. While I believe calcium was of benefit, I think it would be a mistake to attribute all his improvement to this remedy, as he had improved considerably before he took any calcium.

Myotonia atrophica is an interesting condition. Many neurologists have observed atrophy of the muscles occurring with Thomsen's disease, but it is only recently that certain neurologists (Steinert, Batten, and Gibbs) have attempted to make a distinct type.

Myotonia, with symptoms of syringomyelia or of multiple sclerosis, should be discarded as not belonging to this type. Steinert finds that the atrophy begins in the hands, and is associated with atrophy of the sternocleidomastoid muscles and of those of the face. The commencement of the atrophy in the hands he regards as diagnostic. Batten and Gibb collected the reports of 27 cases; of these, 12 were rejected as not belonging to the type. Dr. Pemberton's case is not entirely typical, in that the muscles of the hands are not wasted, and yet there is no good reason why it should not be regarded as a case of myotonia atrophica. Muscular dystrophy rarely begins in the hands; and yet Gowers has reported a case of this character, and I have also, and my case was with necropsy.

ANTERIOR POLIOMYELITIS[1]

By JOSEPH S. NEFF, M.D.

The discussion of anterior poliomyelitis from the standpoint of the health officer may not be as interesting in a meeting of this character as a discussion from the standpoint of the bacteriologist, of the pathologist, or of the clinician, concerning etiology and treatment; but the part played by the field-worker is of considerable importance in prevention. It was a number of years after the discovery of the microörganism causing malaria, and the knowledge of the structural changes pointed out by the pathologist, that we learned through the efforts of the field-worker that the mosquito was the cause of the spread of the disease, until which discovery we were unable to adopt any systematic course for its prevention; and notwithstanding the great work already accomplished in the laboratory, especially by Flexner and Lewis in this country and by Landsteiner and Levaditi abroad, it may be the field-worker who will suggest thought and a line of study which will enable the more scientific research worker to solve this serious problem that is now confronting both continents.

Following the course of investigation mapped out by the State Board of Health of Massachusetts, where the disease has been present in epidemic form for several years, I have made as careful a study as possible of the cases reported in Philadelphia during the past summer. The results in themselves, with possibly two exceptions, demonstrate very little, and become of value only in adding to the statistics already obtained and to be obtained in

[1] Read, October 14, 1910.

other communities for further study and deductions; the two exceptions being the part played in the etiology of the disease by feeding and by general housing conditions.

In a study of 99 cases in Philadelphia we find that 6 were breast--fed, alone, 11 bottle-fed, 43 mixed-fed, and 38 partook of ordinary table food.

Dr. Lovett, in his report of 150 cases in Massachusetts, makes the important note that no child living on breast milk alone was affected by the disease. The other important point in Philadelphia which is graphically displayed on the "spot map" I herewith present, shows the practical absence of the disease in the second, third, fourth, fifth, sixth, seventh, eighth, tenth, eleventh, twelfth, thirteenth, fourteenth, sixteenth, seventeenth, eighteenth, and thirty-first wards—there being but one case each in the second, third, fourth, fifth, eleventh, thirteenth, fourteenth, eighteenth, and thirty-first wards, and none in the rest of the wards mentioned; and the only location in Philadelphia with apparent grouping of cases is in the western end of the forty-fourth and the eastern end of the thirty-fourth wards in the neighborhood between Fifty-second and Sixty-third Streets, running several blocks north of Market Street. The first group of wards mentioned are those with the highest congestion of population, and the last two named are those with the lowest ratio (excepting surburban wards) of population per acre. For example, the following table shows that in the river wards we have as high as 205 individuals per acre, and in the West Philadelphia wards as low as 14 per acre. The people down town live in what is known as the lodging and tenement house district, the population being largely foreign. The wards along the river in the northern section of the city contain a large number of mill and factory workers, the population being slightly foreign. In both these districts the houses are old, the drainage poor, and the plumbing, in many cases, antiquated; and in the West Philadelphia wards the houses are new, the drainage good, and the plumbing, in nearly all cases, in accordance with the rules and regulations of the Board of Health, which tends to show that general sanitation, crowding, and housing conditions do not

play a part, at least in Philadelphia, in the etiology of this disease.[1]

Ward.	Population per acre.	Cases.	Ward.	Population per acre.	Cases.
2	127.2	1	12	123.5	0
3	205.1	1	13	114.9	1
4	157.7	0	14	139.9	1
5	83.3	1	16	92.3	0
6	39.0	0	17	117.5	0
7	109.4	0	18	72.8	1
8	56.4	0	31	72.5	1
10	90.2	0	34	14.8	11
11	92.7	1	44	50.8	6

We have had 1 case in a Children's Home, 1 in a hotel, 3 in tenement houses, 1 on a farm, and 82 in private houses. Special attention is called to the absence of the disease in hospitals and large institutions containing many children. Of the cases reported, 58 were females and 39 males; there were 9 deaths, making the mortality 9 per cent.

In the families of the 99 cases there were 194 other children, but 2 of which developed the disease, there being 93 reported as primary and 2 as secondary. This does not bear out the record of other investigators, especially Hill, of Minnesota, who made a careful study of 161 cases, in which list he had 17 per cent. contact or secondary cases.

From a study of all cases reported, it is evident that poliomyelitis is very mildly contagious, and much less so than the other so-called children's diseases. Scarlet fever, typhoid fever, and diphtheria show secondary cases to run from about 40 per cent. in the former to 30 per cent. in the latter.

But two cases were found who had been in contact with acquaintances suffering from the disease.

The condition of the homes and drainage, although showing little, is given for the purpose of statistical study. As naturally would be expected in a city like Philadelphia, we found the condition of the houses to be old in 78 cases and new in but 23, dry in 65 cases,

[1] In this connection I may state that in the study of the cases of cerebrospinal meningitis in this city similar conditions were found. Sanitary environment was shown not to be a dominating factor in its etiology, as 80 per cent. of the houses in which cases were found were reported as sanitary.

damp in 26; 67 were connected with the city sewer; 23 had privy wells. In 21 there was much dust, in 61 moderate dust, and in 13 no dust. In 65 houses both mosquitoes and flies were present; in 3, mosquitoes alone, in 2 flies alone, and in 20 neither mosquitoes nor flies. In 33 families there were no animals of any kind; in 56 there were as follows:

In 4 homes, 1 dog and 1 cat.
In 2 homes, 2 dogs.
In 1 home, 1 dog and 2 cats.
In 1 home, 1 dog, 1 cat, and 1 horse.
In 9 homes, 1 cat.
In 3 homes, 1 cat and mice.
In 4 homes, 2 cats and mice.
In 25 homes, mice.
In 1 home, 2 dogs, 1 cat, mice, and 60 chickens.
In 1 home, 1 dog and mice.
In 4 homes, 14 cows and 20 pigs.
In 1 home, 1 cat and 15 pigeons.
In 2 homes, 1 cat and 1 chicken.
In 1 home, 1 cat and 2 chickens.
In 2 homes, birds.
In 1 home, 1 dog, 50 chickens, and 2 hens.
In 1 home, 1 dog and 4 chickens.
In 1 home, 12 chickens and 10 birds.

In all of these cases, with but three exceptions, the animals were well. In one home one cat was sick three weeks before onset of the disease; cause unknown. In the case of the home with 12 chickens and 10 birds, 1 bird died a few days previous to the outbreak of the disease, cause unknown. In one of the two homes mentioned with 1 cat and 1 chicken, the chicken was found dead in the cellar two days prior to the first case of poliomyelitis. It was in this house one of the secondary cases was found, the disease developing three days after the first case; that is, the chicken was found dead July 23, and the first case was taken sick July 25 and the second July 28; cause of death of chicken unknown. The first case had high temperature, anorexia three days later, and one day before the appearance of paralysis in the first case the second case developed.

Owing to the reports from Swedish investigators showing the frequency of the disease along the line of railroads, although this may not apply so much to urban as suburban cases, we have found the relation of cases in Philadelphia to railroads as follows:

6 within 20 yards.
4 within 50 yards.
4 within 100 yards.
12 within 200 yards.
12 within 300 yards.
11 within 500 yards.
49 over 500 yards.

As to connection with water we found:

1 within 100 yards.	2 within 500 yards.
2 within 200 yards.	3 within 700 yards.
7 within 300 yards.	12 within 800 yards.
9 within 400 yards.	64 over 800 yards.

As the time of registration of cases has been so short, the incis dence of the disease in Philadelphia is as yet of little value, casehaving been reported here only since July 14, 1910. In this connection it may be of interest to note the practice in other communities, which was discussed at an informal conference of a number of delegates at the recent meeting in Milwaukee of the American Public Health Association, further mention of which will be made later.

In New Jersey anterior poliomyelitis is reportable as infectious, communicable, and contagious.

In New York, reportable September, 1910.

In Massachusetts, reportable as contagious since November, 1909.

In Virginia, reportable in the fall of 1910.

In Hamilton, Ontario, reportable in May, 1910.

In Minnesota, reportable and quarantined since 1908.

Iowa has no authority, but requests physicians to report.

The United States Public Health and Marine Hospital Service has requested State Boards of Health to report.

The following do not require any reports: California, South Carolina, Washington, D. C., and Providence, Rhode Island. These were the sections of the country represented at the conference above mentioned.

In Philadelphia the origin of the cases was as follows:

Prior to January 1, 1910	2	July	31
February	1	August	34
April	1	September	24
June	4	October	2

TEMPERATURE AND RAINFALL

Week ending		Onset of disease. Cases.	Average mean daily tempera-ture, F.°	Rainfall, inches.	Week ending.		Onset of disease. Cases.	Average mean daily tempera-ture, F.°	Rainfall, inches.
Prior to Jan., 1910		2	..	..	July	16	7	79.3	0.05
February	14	1	..	..	July	23	10	72.0	0.59
April	30	1	58.0	1.91	July	30	8	80.0	0.92
May	7	0	56.0	0.25	August	6	14	75.0	0.76
May	14	0	59.0	0.45	August	13	7	72.9	1.36
May	21	0	63.0	0.84	August	20	5	71.0	3.07
May	28	0	65.0	0.54	August	27	8	72.0	0.36
June	4	0	62.0	0.15	September	3	3	68.0	2.15
June	11	2	61.0	2.79	September	10	8	73.1	1.00
June	18	0	68.0	1.96	September	17	5	68.2	0.00
June	25	2	77.0	0.00	September	24	8	66.4	0.01
July	2	0	76.3	0.51	October	1	3	67.7	0.00
July	9	6	77.0	0.28					

NOTE.—Especial attention is called to the fact that the week ending July 23 and the week ending August 6, in which the greatest number of cases occurred, followed the hottest weeks of the summer.

The age of onset corresponds with other reports:

3 months	1	26 months	1
4 months	1	30 months	4
5 months	1	32 months	1
7 months	1	3 years	10
8 months	1	4 years	5
9 months	1	5 years	5
10 months	3	5½ years	1
11 months	1	6 years	1
14 months	2	6½ years	1
15 months	2	7 years	3
16 months	3	8 years	1
17 months	1	11 years	1
18 months	8	14 years	1
19 months	2	17 years	1
21 months	1	19 years	1
24 months	13		

Average: 3 years, 1 month, 11 days.

NOTE.—In cerebrospinal meningitis, age seemingly figured as a predisposing factor, as but 6 per cent. of the cases were over thirty, and 80 per cent. were under twenty years of age.

In 31 cases there were disturbances of digestion preceding the attack; in 66 cases there was none. In 43 cases there were disturbances of digestion during the attack, and none in 51 cases. The symptoms before the onset of paralysis were as follows:

In 22 cases none.
In 45 cases fever.
In 34 cases vomiting.
In 20 cases diarrhea.
In 7 cases convulsions.
In 6 cases headache.
In 6 cases pains in limbs.
In 5 cases general lassitude.
In 4 cases pains in neck.
In 4 cases constipation.
In 4 cases gastro-intestinal irritation.
In 3 cases nausea.
In 2 cases hyperesthesia.
In 2 cases anorexia.
In 2 cases chills.
In 2 cases pains in back.
In 2 cases abdominal pain.
In 1 case suppression of urine.
In 1 case stiffness of limbs.

As many had several symptoms, the total is in excess of the total number of cases.

As possible conditions favoring the attack there was 1 case recovering from whooping cough; 3 cases recovered from whooping cough within three months of onset; 2 cases recovered from pneumonia within three weeks; 1 within five weeks; 2 cases recovered from measles within one month; 1 had an unhealed ulcer resulting from vaccination three months prior to the attack; 1 case injured a hip immediately preceding the appearance of paralysis; 1 case fell, striking the head, six days prior to onset; 2 cases recovered from tonsillitis within two months of onset; 1 case recovered from marasmus within two months of onset; 1 case, child, aged one and one-half years, eight days after onset passed seventy-five worms one inch in length and one-sixteenth inch in width, which was stated by the attending physician to be, in his judgment, larvæ.

Distribution of Paralysis

Cases.	Cases.
7 right arm.	23 both legs.
3 left arm.	7 both legs and both arms.
14 right leg.	1 both legs, both arms and diaphragm.
14 left leg.	1 muscles of the neck.
4 right arm and right leg.	1 muscles of the face.
4 right arm and left leg.	2 both arms, both legs, and face.
2 left arm and left leg.	2 diaphragm and both legs.
3 left arm and right leg.	1 complete paralysis.
2 right arm and both legs.	1 neck, both arms, and both legs.
1 left arm and both legs.	1 diaphragm and both arms.
4 both arms.	1 diaphragm, both legs and neck.

Time of Appearance of Paralysis after Onset of Disease

Days.	Cases.	Days.	Cases.
1	36	8	1
2	16	10	2
3	14	14	6
4	9	21	1
5	4	22	1
6	1	48	1
7	7		

The main point to be taken into consideration by health officials, until more definite knowledge of the exact cause and spread of the disease is obtained, is the means of prevention. Their duty is to prevent the spread of disease; but at the same time the welfare and comfort of the community must be considered. The questions involved are as to isolation, quarantine, exclusion from school of other children in the family, placarding, etc. Up to the present time, and in view of the approaching cold weather, the health authorities of Philadelphia have done nothing further than to order isolation of the patient and the disinfection of all discharges.

At the informal conference at Milwaukee, where those in attendance had given the subject much consideration, the opinion was unanimous that the disease should be reportable. There was considerable discussion as to quarantine and exclusion from school, the majority being in favor of both. My own thought is to await developments next spring. Should we have isolated cases only, no further action will be needed. Should, however, the disease become epidemic, my present thought is to compel the isolation of the patient, exclude from school other children in the family for a period slightly beyond the incubation period of the disease, and give written instructions as to the disinfection of all discharges; but I do not believe it necessary to placard the house. This procedure may be too severe, as, personally, from a careful study of cases reported, I fail to find much benefit from isolation. There seems to be as many secondary cases where isolation has been maintained as where it was not attempted.

The small number of cases constituting this study precludes drawing any positive conclusions, and are presented, as I said, as a contribution to those already reported.

SOME RECENT CLINICAL INVESTIGATIONS OF POLIOMYELITIS[1]

By CHARLES K. MILLS, M.D.

Since June of the present year (1910) I have had the opportunity of studying about forty-five cases of poliomyelitis, and of course have had the usual experience of the neurologist with the disease for many years, this including the observation of cases extending into the hundreds. What I have to say in this paper about some special features in symptomatology, diagnosis, and treatment is in the main based upon my recent experience.

A discussion of the subject naturally divides itself into a consideration of the acute and residual manifestations.

ABORTIVE CASES.

A considerable number of facts came to my knowledge while studying the disease at Bethlehem and elsewhere in the Lehigh Valley, and also in Philadelphia in the ordinary course of my work during the last few months, which seem to indicate that instances of the disease of a mild or abortive type occurred and were frequently overlooked. Children in the same neighborhood and sometimes in the same family as those suffering from well-marked acute and residual phenomena of the disease were reported to others and myself as suffering from slight fever, malaise with digestive or other symptoms, and sometimes with a passing weakness of one or more limbs. Such cases have importance in a general study of an endemic or epidemic, as showing that the

[1] Read October 14, 1910.

infection of the disease may be more widespread in its influence than appears from a knowledge of the disease as illustrated by well-defined examples. Some of those who have discussed the epidemics occurring in different parts of this country, as well as in Norway and elsewhere abroad, have directed attention to this matter of abortive types of poliomyelitis.

FULMINANT OR RAPIDLY FATAL CASES

In Bethlehem I received information regarding three cases of fever which were rapidly fatal and which probably were examples of poliomyelitis. The diagnosis of these cases, owing to their speedy termination, could not be fully made. The children were under three years of age and died within forty-eight hours of the onset of high fever, with delirium and convulsions, with, in two instances, retraction of the head and digestive disturbances. Death apparently resulted from the overwhelming influence of some toxemia.

In Philadelphia a healthy, strong young adult, who had been quite well, was taken with feelings of weakness and general distress for which he could not account, and in less than two days, although he still remained on his feet, he was found to have some fever, and then went to bed. Some loss of power was evident in his upper extremities, although the gravity of his condition was not fully recognized. His mind remained clear. He rapidly sank and died within four days of the recognition of his first symptoms.

In another case, that of a man between thirty and forty years of age, with high fever, the patient's condition pointed to poliomyelitis and bulbar encephalitis. He died within a week of the onset, paralysis having appeared before death in the limbs of both sides and in the domain of the facial, glossopharyngeal, and other cranial nerves. Paralysis in this case was chiefly of the flaccid type.

Through the courtesy of Dr. M. Howard Fussell I obtained a necropsy on one fulminant case, that of a child about seven years

of age, who died within four or five days after the onset of fever. The paralysis was of both the bulbar and spinal type, this being more marked in the upper extremities and cranial nerves than in the lower extremities.

A microscopic examination was made in this case by Dr. E. M. Williams, of the clinical and pathological staff of the neurological department of the University of Pennsylvania, who has furnished me with the following preliminary report upon his findings: Macroscopically, no change was visible other than a congestion in the meninges, with some irregularity in the shape of the cord in the cervical region. Sections were made from the Rolandic area in the cortex, the cerebellum, the oblongata, and the lower cervical, mid-dorsal, and lumbar regions of the cord. Section of the cortex showed a general weakness in the staining qualities of the chromophile bodies in the cells, there being a diffuse pale staining of the entire cell. The nuclei were indistinct, but no evidence of neuronophagocytosis was present. There were a few very small areas of beginning softening.

The meninges were very tensely congested and somewhat infiltrated, being of a lymphocytic character. Few leukocytes were present. Many cells resembling in size and shape the so-called plasma cells were found throughout the pia. Extensions of the pia into the substance of the brain were also greatly infiltrated and congested. There was no distinct infiltration of the substance itself.

The cellular changes above noted might have been either toxemic or post mortem, as there was no sign of degeneration other than the chromolysis above mentioned, the nuclei being centrally placed with very few exceptions.

The cerebellar cortex, as well as sections of the dentate nucleus, showed no pathological changes.

In sections of the oblongata intense infiltration, both around and in the vessel walls, was present, and the vessels were very greatly congested. In some areas were clumps of round cells resembling in appearance abscess formation, in these cases round cells taking the place of polymorphonuclear leukocytes. Fairly

numerous areas of softening occurred throughout the section, in many cases with hemorrhagic extravasation. The cellular degeneration was very marked, particularly in the posterior or dorsal part of the oblongata. The cells forming the ninth, tenth, and eleventh nuclei were greatly affected. The nuclei of these cells were often somewhat blurred. The cells also of the inferior olive of the lateral nuclei were somewhat degenerated. In contrast to these the nucleus of the twelfth stood out distinctly and clearly with well-stained tigroid bodies and distinct nuclei. In only a few cells was the slightest sign of disintegration, this being shown by a slight lessening in the number and clear staining qualities of the tigroid bodies.

The sections of the cervical segment showed the meninges decidedly congested and infiltrated, the infiltration being of a round-cell character. The ventral part of the cord was especially involved, the vessels here being swollen and congested, and the membranes apparently thickened. The anterior roots showed a swelling of the medullary sheaths. Throughout the entire section was complete destruction of the cellular element of the gray matter, the only remnant of the cells being an occasional irregularly shaped nucleus. The lymphocytic infiltration was intense, particularly throughout the gray matter. It was most marked in the coats of the vessels and also extended throughout the surrounding tissue. Many areas of softening were present in the white matter. This was marked in the anterior and anterolateral parts of the cord near the periphery. In some of these areas was total destruction of the fibers. In others, where the softening was apparently just beginning, the myelin sheaths were swollen and edematous and the axis cylinders were irregular in shape, laterally displaced, sometimes swollen, and even broken up.

Sections in the mid-dorsal region also showed intense infiltrative changes with thickening of the pia, but the infiltration was not so great as in the cervical region, while the cells in the anterior horns in this section were all destroyed. A great many cells of the posterior horns were also slightly degenerated; some of these in Clarke's column, and posterior and lateral to Clarke's column,

still showed well staining chromophile bodies and distinctly outlined nuclei. Others in these groups had peripherally arranged tigroid bodies. Even these cells had not the clear-cut, regular chromophile bodies such as those found in normal cells, and were probably somewhat affected by the toxemic condition.

The lumbar region showed thickening of the pia with marked round-cell infiltration, this being particularly noticeable in the anterior part, where the vessels were especially congested and infiltrated. These cellular substances showed the same great degree of infiltration, with an absence of all posterior horn cells. The anterior cells, however, were only in a few instances totally destroyed. Most of them had normally placed nuclei, although the chromophile bodies stained very poorly, and there was probably a certain degree of toxemic changes present.

VARIETIES IN ONSET AND COURSE

In several of the cases of poliomyelitis observed by me during the recent epidemic the symptoms usually present at the onset of the disease were absent, or, what is more probable, were overlooked. The parents and family were unaware of any febrile, gastro-intestinal, or nervous symptoms, their attention having been first directed to the disease by the awkwardness or absence of movements in the affected parts.

The onset and acute stage of the disease were usually after the fashion described in the text-books, namely, the sudden beginning with fever, the paralysis being observed in from two to four days after the first febrile manifestations, this increasing steadily to a maximum and then regressing.

In two instances the pre-paralytic stage was long, the paralysis not appearing until the second week.

In three instances the disease assumed a relapsing or recrudescing type. In all of these the musculature of one part of the body was attacked. The fever disappeared, and with its reappearance another part became the seat of the paralysis. In these cases the lower extremities were commonly first affected, the upper later.

In one, bulbar and cerebral symptoms appeared, and death resulted.

In this case the patient was a boy, aged thirteen years, who, after a high fever, was paralyzed in both upper and lower extremities, the abdominal and thoracic muscles, the diaphragm escaping. Some paralysis of the muscles of articulation was present, and the left abducens was paretic, the patient having diplopia. On the tenth and eleventh days after the onset the temperature had returned to normal and the stage of regression seemed to have begun, but two days later the temperature again began to rise, and after one or two oscillations remained high, paralysis of respiration set in, and death ensued.

The second recrudescing case was that of a boy aged about one year. Early in July he had pain in his lower extremities, and in a day or two was paralyzed in them. When first seen by me, on September 12, he was partially paralyzed in both lower extremities, more on the right side than on the left, and most markedly in the peroneal muscles, although there was some impairment of power in flexing and extending the thighs. Ten days after this examination the child had some fever and general distress, and was found to be paralyzed in both upper extremities, most marked proximally. He also had difficulty in holding his head erect, apparently from paralysis of the muscles of the neck.

PERIOD OF INCUBATION

The period of incubation of poliomyelitis is a matter of some interest and one which seems to have received but little attention from writers on the subject. It is difficult to get facts of value bearing upon this question, but a few observations indicate that this period ranged between a week and three weeks. In the majority of cases it is probably from one to two weeks.

Two boys, aged, respectively, nine and thirteen years, were seized with the disease while on an island on the Virginia coast, they having come from Bethlehem, in one instance one week, and in the other nine days, before the first symptoms of the acute stage

of the disease appeared. As no other case appeared among the children, about thirty in number, who were present in the same camp, this observation seemed to indicate that the period of incubation was at least one to two weeks in length. In another case seen by me at Stroudsburg, the only instance of the disease in this city up to the time of my visit, the patient, a boy of about ten years of age had been, with other members of his family, in the Connecticut Valley, at a point about ten miles from Springfield, where the disease, as is well known, exhibited great virulence, the endemic there having had many serious and even fatal cases. In one case seen at Bethlehem the child had gone from one portion of the borough where the disease had appeared in others, to another which was relatively free, the symptoms of poliomyelitis appearing about a week after the change of location. In two other cases the evidence seemed clear that infection had taken place a little less than two weeks before the change of location.

CLINICAL TYPES ACCORDING TO THE LOCATION OF THE LESION AND RESIDUAL PARALYSIS

It is not my intention, either from recent personal experience or from a study of literature, to present statistics regarding poliomyelitis, but rather to concentrate the attention of others, as my own attention has been concentrated, on a few salient features of the disease as shown in the cases recently observed The statistics of value regarding the occurrence and special features of poliomyelitis are those which are now being presented in current journals, in reports of medical associations, and of State, county, and municipal boards of health. In the main these agree as to the age most frequently attacked, being below three or four years; as to the most virulent months of prevalence of the disease being July, August, and September; as to the disease being most commonly rural; as to the residual paralysis being usually in one or both lower extremities; as to the existence of some fulminant and many abortive cases; as to the usually serious significance of symptoms showing implication of bulbar centres; and as to the probable

infective nature of the disease. My own recent experience is in accordance with these well-known determinations.

All but five of the forty-five cases were instances of the disease which have occurred since May of the present year. The others, although studied during recent months, were left paralyzed by previous attacks, these, however, having been within two or three years.

A classification of these cases, chiefly according to the location of the lesion and the residual paralysis, cannot be thoroughly made, but an abstract statement of them may be given.

Five cases belong to the fulminant type to which reference has been made; 5 were abortive cases; 8 were cases of paralysis in one lower extremity; 15, of paralysis in both lower extremities; 12, in four or three extremities, usually four; in 1 case the paralysis was confined to the upper extremities; 1 was a case of uncomplicated bulbar paralysis (facial); in 5 cases paralysis of the extremities was associated with bulbar paralysis.

In the majority of cases of paralysis involving both upper and lower extremities the abdominal and other trunkal muscles were implicated early. The abdominal paralysis persisted in several instances. The bladder escaped except in two or three cases. Constipation, which may have been due, in some of the instances at least, to a paralyzed condition of the bowels, was the rule, diarrhea being present only in a few cases, although my data on this matter are not full. In the fulminant cases both bulbar and cerebral centres (cortex and basal ganglia) were, from the symptomatology, probably involved. In the one case with necropsy this widespread implication was determined.

While the assault of bulbar centres is always of serious significance, it was nevertheless shown by a study of these cases that cranial nerves, like the facial, might be the seat of residual paralysis in patients who make good or comparatively good general recoveries.

In 5 cases the disease occurred in adults, 3 of these being between the ages of twenty and thirty years, 1 between thirty and forty, and 1 between forty and fifty years.

In the cases recently seen I have not observed any well-defined instance of paralysis seemingly due to Strümpel's circumscribed cortical encephalitis. I can see no reason, however, why such cases may not occur, and a few have been recorded. In the fulminant cases to which attention has been directed, in fact, all parts of the brain as well as the bulbar and spinal portions of the nervous system, are doubtless often the seat of inflammation. In cases with necropsy and microscopic examination, studied in connection with epidemics of poliomyelitis which have occurred especially in Norway and Sweden and in this country, lesions, practically identical with those in the cord, have been found not only in the cortex but also in the basal ganglia. In most of these cases the effects of the inflammation upon the encephalitic tissues have not been sufficient to bring about permanent residual palsies like those left by the cornual inflammation. The toxemia, in other words, has been more destructive to cord centres than to those of the higher regions of the nervous system. Cases have been observed, however, in which a combination of cortical paralysis has been associated with evidences of spinal atrophic paralysis or of bulbar atrophic paralysis.

Cases with symptoms of onset like poliomyelitis and with the so-called cerebello-rubro-spinal symptomatology—coarse tremor, with some paresis and rigidity, the whole somewhat like paralysis agitans or a mixture of this disease and multiple sclerosis—have also not been observed, although in one child some ataxia was present.

The comparative frequency with which the upper as well as the lower extremities were left paralyzed is of much interest and shows the seriousness of the infection. The residual paralysis in the upper extremities was usually much more decidedly proximal than distal, the movements of the shoulder and upper arm suffering most. These observations as to the frequency and severity in the epidemic of cervical lesions are in accordance with those made by some other recent observers.

DIAGNOSIS

While the diagnosis of poliomyelitis is usually not difficult, mistakes are not infrequently made in the early days of the disease. In the period of residual paralysis, the differential features of the disease are now so well known as scarcely to need discussion. They are chiefly the presence of flaccid paralysis, often localized to parts of one or more limbs, with decreased reflexes, atrophy, vasomotor changes, lost faradic irritability, and changes in galvanic reactions, secondary contractures and deformities, the absence of sensory phenomena, the rarity of paralytic implication of the bladder, and the sparing of the cerebral functions and faculties. The diagnosis occasionally needs some consideration when the paralysis chances to attack an arm and leg on one side, as is the case commonly in the cerebral palsies of children, but the residual phenomena are here so radically different as not to cause much doubt or confusion. In the cerebral cases, spasticity instead of flaccidity, increased instead of decreased reflexes, retained response to the electrical currents, and the presence of other evidences of cerebral involvement, including even the history of an apoplectiform and convulsive onset, will assist in the easy differentiation.

A knowledge of the existence of an endemic or epidemic of poliomyelitis is, of course, an aid to diagnosis, but may occasionally be misleading most probably in the direction of an erroneous diagnosis of the disease when a child is attacked with fever due to digestive disorders or with an exanthematous affection.

At the onset there is very little to distinguish the fever of poliomyelitis from that of any other infectious or contagious disease of childhood. Of course, in the case of exanthemata the appearance of the distinctive eruption identifies the disease, but this help is not available in the case of diseases like typhoid and malarial fevers. Gastro-intestinal irritation—vomiting and diarrhea—is frequent in the acute stage of poliomyelitis, and yet constipation was the rule in the cases observed by me in the present epidemic. The occurrence of cases similarly affected in the same locality and

especially in the same family, always leads to the suspicion of the existence of the disease. The fever of poliomyelitis presents so many variations in its intensity as to be misleading. The severity of the phenomena in the febrile stage appears to be to a considerable extent dependent upon the degree to which the cord is invaded A case in which the entire spinal cord and even higher levels are toxemic as a result of the peculiar infection of poliomyelitis, gives fever of high grade. In a severe case of poliomyelitis a study of the musculature of the thorax and abdomen, even during the first days of the disease, may be of some advantage. The abdominal and thoracic walls become, if not paralyzed, at least partially so, in a considerable number of cases—facts which are evidenced by peculiar breathing, and by relaxation of the abdominal walls.

The deep reflexes may be affected very early before paralysis is suspected. It follows especially that in every case of acute fever, obscure in its nature, occurring in children or youths, the reflexes should be thoroughly investigated.

At the very beginning of the disease, as is also true with multiple neuritis in children or adults, the knee-jerk, and perhaps other deep reflexes, may be increased, but this soon gives way to decrease or loss.

The point of importance is, that while it is impossible to give any rule as to the time of the coming on of the paralysis and diminished reflexes, these usually occur before, sometimes considerably before, the physician recognizes their presence. In no small number of cases recently studied, the paralysis and impaired reflexes were overlooked for some days.

The erroneous diagnosis most frequently made during the acute stage of poliomyelitis at a time when the disease is prevalent is undoubtedly meningitis. This may be believed by the physician to be the epidemic form of cerebrospinal meningitis, or the diagnosis of meningitis is made without any definite idea as to its character or infectious nature. This mistake is due in some instances to the fact that the patient presents for a short time clinical phenomena such as convulsion, retraction of the head, delirium, and pain or hyperesthesia in the back or limbs, which are most readily

explained on the supposition of a meningitis. Indeed, as necropsies have shown, some involvement of the meninges not infrequently occurs, and is the best explanation of such symptoms. In the case studied for me by Dr. Williams, the pia both of the cord and of the brain was congested and infiltrated. The inflammation of the membranes, however, is different in type and intensity from that which is present in true epidemic or sporadic meningitis. The severe, persistent, and destructive effects of the toxine of poliomyelitis fall upon the substance of the cord and brain, when the latter is attacked, and especially upon its gray matter. The meningeal symptoms, therefore, while they may in some cases be present are usually transient. A little time is all that is necessary to enable the physician to determine the preponderance of a non-meningeal symptomatology. In the majority of cases no true meningeal symptoms are present.

Another disease of the nervous system from which poliomyelitis must occasionally be separated even in the acute or subacute stage, is neuritis. Some writers go so far as to speak of a polyneuritic form of poliomyelitis, making such a subdivision because of their belief that the disease is frequently complicated with a true multiple neuritis. While pain on pressure or manipulation over muscle masses and nerves in certain regions is sometimes present during the first week or two of acute poliomyelitis, this is comparatively rare, at least in my experience. Even when pain in the back or limbs is complained of, this is by no means always due either to meningitis or neuritis, although it may have either of these origins in a limited number of cases. I paid particular attention to the presence and character of the pain in some of the cases recently investigated.

In some of the articles on poliomyelitis in text-books it is set down that pain is to be looked for almost as a matter of course in the head, back, limbs, or trunk In a considerable majority of cases which I have studied, however, pain was absent, if the reports of the physicians, the parents, and members of the family who had the patient under observation, could be depended upon. In others, however, pain was a marked feature. Usually it disap-

peared after two, three, or four days. The pain was variously located.

One patient, a boy, aged nineteen years, who gave a very clear account of his early symptoms, said that pain was present in the head, neck, and shoulders; also for a short time in both lower extremities, and in this case the paralysis in the arms and neck and some weakness in the lower extremities came on while the patient was on his feet, and the case was diagnosticated by a physician who saw him as walking typhoid fever. He described the pain as having been of a very severe and worrisome character, especially that which he suffered in his shoulders and upper arms, these being the regions in which the residual paralysis was most marked. Paralysis in the legs was, in fact, never positively present, although both knee-jerks were absent. In another case in which some of the muscles of the neck were temporarily paralyzed, the patient complained of pain in this region.

I am satisfied that in many instances in which handling the little patients seemed to cause pain, the manifestations were simply evidences of general distress, restlessness, and apprehension—were, in other words, psychic.

Tenderness in long nerve trunks and in muscle masses, such as is so frequently present in multiple neuritis, was usually absent. In two cases, however, it was present for seven or eight days from the time of onset.

It must not be overlooked that now and then a case of multiple neuritis is observed during the presence of epidemic poliomyelitis. I have seen one remarkable instance of this sort in an adult who had suffered in infancy with poliomyelitis possibly pointing to the fact that although this patient, because of his attack of many years previous, was immune from poliomyelitis, the infection may have taken the form of a multiple neuritis in his case.

Some of the pain which is complained of by patients during the early period after the disappearance of acute symptoms, say during the second, third, and fourth weeks of the disease, is apparently due to the unusual position and dragging of the limbs, these causing great distress, which the patient commonly refers to the joints.

This was very marked in three cases in and around the knee-joint on one side, although in two of the three the paralysis was widespread in both extremities Two of these patients complained bitterly when the limb was handled and required it to be placed in a position of flexion of the leg almost at right angles to the thigh, in order to get relief. Tenderness due to pressure on muscle or nerve trunks was not present in these cases. The handling seemed to cause distress through the production of certain malpositions of the limb—malpositions, at least, as regards the patient's consciousness. In these cases, after the lapse of two or three weeks, the pain disappeared, and the limb could be handled with impunity.

TREATMENT

In concluding this paper I shall say a few words about treatment, although, unfortunately, I have nothing much that is new to present. Generally, I have used or have suggested the therapeutic measures indicated in what follows.

As the nature of the microörganism or toxin producing poliomyelitis is still unknown, no treatment directly applicable to the pathological cause of the disease can be used. Treatment with our present lights should be directed, in the first place, to the febrile phenomena and to possible elimination through the skin and gastro-intestinal tract. Fever mixtures containing diaphoretics, and sometimes combined with moderate amounts of bromide to relieve cortical irritability should be used. Sponge bathing with cool or tepid water is of service, and the patient should be made, if possible, to drink freely of pure water The hot pack, which has been recommended by various writers on the subject, can be used with much benefit, and is especially valuable in serious cases with high fever.

The bowels should be opened, preferably with small doses of calomel, followed by a moderate saline or castor oil. Especially when constipation is present, and this has been the rule in the cases recently coming under personal observation, the laxatives should be used daily, although not in large doses. An enema of oil, or

of this with soap and water, can be resorted to when difficulty is experienced in opening the bowels.

Ergot has had some advocates, and may be tried, most efficiently either by the administration of a good fluidextract or by the hypodermic injection of some preparation like ergot antiseptic. The dose used when given by the mouth varies with the age of the patient, ranging usually between 10 and 30 minims. On the whole, I have not seen much benefit from administering ergot, although it has some considerations in its favor,

Counterirritation, either in the form of extreme heat or cold or wet cups, has not proved of much value. The so-called Bier's method of using large cups retained for a long time in position along the spine is theoretically a mode of treatment to be approved. The cups should be kept on for long periods, with shorter periods off, say, for instance, two hours on and one off, this treatment being kept up for several days. It is probably effective, if at all, not in producing anemia of the cord, but in stimulating the activity of absorption. Some difficulty is experienced in using these large cups on children They were used under my direction in two cases, and in one of these cases, a boy, aged about nine years, with apparent benefit. though I could not be certain of the amount of good that was accomplished through the method, as other methods were used

The patient should be kept as quiet as possible, and not in one position all the time. It is especially desirable not to allow him to be continuously in the supine position, although probably not as much is accomplished by the prone position or position on the side as is sometimes believed.

Urotropin, because of its known action in cases of meningitis, has something in its favor, and might be used in small doses for a time. One or 2 grains can be given every two or three hours to small children, and as much as 5 or more to other patients.

The use of mercury in small doses as the acute stage is subsiding may be of some service. Salicylates have been advocated, especially when pain is present, but are of doubtful value. They are probably of advantage when real neuritis is present. When pain and hyperesthesia are present in the limbs, application of hot water

for a few minutes to the painful regions can be used and the parts between these applications can be wrapped in rubber dam or in light warm flannels.

The diet should be light and unstimulating during the febrile stage. The bladder should be catheterized if the urine cannot be passed, although, fortunately, this procedure is not often necessary.

My experience with lumbar puncture has been very limited, but it is desirable to resort to it for therapeutic reasons in the more severe cases. Some benefit from its use has been observed by others, especially in cases in which the symptoms of the acute stage are serious or threatening.

When paralysis of respiration is threatened through involvement of bulbar centres, oxygen inhalations may be tried, and also the hypodermic use of remedies such as atropine, strychnine, and nitroglycerin. In one of my cases the most strenuous efforts were made to maintain respiration and cardiac action by such measures, but without avail.

Efforts to treat the paralyzed limbs electrically should not be begun too early, although, for the purpose of assisting the prognosis, a few tests may be carefully made at the end of the first or second week After all the acute symptoms have subsided, and the residual paralysis begins to be evident, treatment with massage, systematic movements, and electricity can be begun. It is best to begin first with gentle massage and passive movements, reserving the electrical treatment for a week or two later. The faradic current may be used for those muscles which respond, although imperfectly, but sooner or later the galvanic current slowly interrupted will be found to be the most desirable. Treatment with massage, movements, and electricity should not be continued too long. A good plan is to use it for a period, then stopping for another period to return to its use. Two or three weeks of use and a one or two weeks' interval without treatment is a good rule to pursue for the first six months or a year. Tenotomies to give better position to the limbs, and the use of light apparatus to assist the muscles which retain their power, can be used to advantage, but should always be resorted to with great thoughtfulness and after very careful investigation of all the facts in the case.

RECENT STUDIES CONCERNING THE ETIOLOGY OF EPIDEMIC POLIOMYELITIS[1]

By PAUL A. LEWIS, M.D.
DIRECTOR OF THE LABORATORY OF THE HENRY PHIPPS INSTITUTE IN THE UNIVERSITY OF PENNSYLVANIA

That I have the privilege of taking part in this symposium is due entirely to the fact that it has been my good fortune to be associated during this past year with Dr. Simon Flexner[2] at the Rockefeller Institute, New York, in certain experimental work with poliomyelitis material. I assume, therefore, that what I can contribute to the meeting is a brief account at first hand of that work, and a summary of our present knowledge of the etiology of the disease in the light of our work and that of others in the same field.

The recent developments in the experimental studies of poliomyelitis were initiated by Lansteiner and Popper,[3] of Vienna, who successfully reproduced the disease in the monkey by the intraperitoneal inoculation of an emulsion of the spinal cord of a child dead of the disease. This experiment was subsequently repeated by Knopfelmacher[4] in Vienna and by Strauss[5] in New York City. These experiments strengthened the evidence that poliomyelitis is an infectious disease, but were not completely demonstrative, because the disease could not be transmitted from animal to animal.

[1] Read by invitation, October 14, 1910.

[2] Flexner and Lewis, Jour. Amer. Med. Assoc., November 13, 1909; December 4, 1909; December 18, 1909; January 1, 1910; February 12, 1910; April 2, 1910; May 28, 1910; August 20, 1910; and Jour. Exper. Med., 1910, xii, 227.

[3] Zeit. für immunitätsforsch. Orig., ii, 377.

[4] Med. Klin., 1909, v, 1671.

[5] Strauss and Huntoon, New York Medical Journal, 1910, xci, 64.

The possibility that the paralysis in the animal inoculated with human material might be due to the transfer of a toxic substance, however unlikely it might appear, could not be excluded.

When we obtained suitable postmortem material, our first step, naturally, was to repeat this experiment; and, following a success in this point, to try to carry the disease from animal to animal. Thinking that the intraperitoneal inoculation of the material might not be the most favorable method, we adopted for our re-inoculations the intracranial injections. Our first attempt by this method led to a paralysis, and the disease has been continued from monkey to monkey continuously for about thirty successive generations. The same results were obtained starting from a second, and then from a third, human case. These results were subsequently obtained by others.

One of the points of special interest in these experiments is the accuracy with which the disease is reproduced in the monkey, both as a clinical picture and as a pathological process. The study of eighty-one cases of paralysis in the monkey made possible the following description of the experimental disease:

Clinical Features. *Incubation Period.* The incubation period has been taken to be the interval elapsing between the time of inoculation and the appearance of the first definite paralysis. During this interval certain other clinical manifestations of illness may be noted, and these will be considered separately as prodromal symptoms. The latter, besides being inconstant, call frequently for the exercise of personal judgment for their detection, and hence they can be defined less accurately than the paralysis. In several instances the monkeys felt ill and died without paralysis having occurred or been noted. These animals were included among the series of successful inoculations only when the typical lesions were present in the nervous system. The incubation period in them was calculated from the inoculation to the onset of definite symptoms of illness.

The shortest period thus far noted as elapsing between the inoculation and the onset of paralysis has been four days, and the longest period thirty-three days. The average period has been 9.82 days.

The number of animals developing paralysis after the twelfth day was 16, and the number developing paralysis before the eighth day was 18. Hence the extremes of the incubation period are probably simple variations from a mean which represents the activity of the virus for monkeys. We possess some evidence that the virus may suffer, in certain strains, an enduring alteration through which its activity is diminished. When the site chosen for inoculation is some other than the brain, or the material used some other than an emulsion of the spinal cord, the incubation period has not usually been at either extreme period.

Prodromal Signs. The inoculation of the virus into the brain or other parts produces no immediate effects. As soon as the effects of the anesthetic disappear, the monkeys appear normal. This condition persists until a period of from six to forty-eight hours before the onset of paralysis, when certain abnormal signs may be noted. The animals become nervous and excitable; on being disturbed and made to move about the cages, they tire quickly; a tremor of the head, face, or limbs develops; when the attention can be attracted, the gaze is shifting rather than fixed, as in the normal monkey, and the face is wrinkled and mobile rather than smooth and placid; the hairs are erected somewhat, and the animals prefer to remain quiet. All these symptoms are almost never noted in a given animal, and they occur in varying combinations. The temperature does not rise constantly during the incubation period, and gastro-intestinal symptoms rarely occur. A few animals have shown diarrhea, but this condition may well have been a coincidence.

Onset of Paralysis. Either with or without the premonitory signs, the paralysis develops suddenly. In general, it may be stated that any of the larger groups of voluntary muscles may be first involved. The table shows the frequency with which the chief types of paralysis developed in our series at the onset.

TABLE I.—FREQUENCY OF CHIEF PARALYSIS AT ONSET

Location of paralysis.	Animals affected.	Total.
Both legs	20	
Right leg	8	
Left leg	12	40
Both arms	3	
Right arm[1]	9	
Left arm	9	21
Four limbs	10	10
Right leg and left arm	1	1
Neck[2]	1	1
Bulbar or cerebral[3]	8	8
Total	81	81

Concomitantly with the appearance of paralysis of any large muscle group, other muscle groups are found either weak or partially paralyzed. The exceptions to this rule are present among the cases of slight affection. The onset of symptoms in the bulbar or cerebral group has not been the same in any two cases, and death has occurred before the developments of flaccid paralysis. The striking features of the cases have been spasticity of the limbs, marked incoördination, resulting in violent pseudo-convulsions; epileptiform convulsions, with tonic and clonic muscle spasms; and, finally, sudden death of apoplectiform type. Death has occurred within thirty minutes of the first appearance of cerebral symptoms.

Usual Type of Paralysis. The rule is for the paralysis to extend quite rapidly to other muscle groups. In mild examples of the affection the extension may be slight or pass unnoticed. In examples of moderate severity, the extension soon ceases. In the usual examples, which are severer than these, the paralysis extends, with greater or less celerity, from one limb to another, to the back and the neck, until death supervenes The paralysis, when developed, is of the flaccid variety. The severely affected animal lies recumbent, the respiration being feeble and shallow and the temperature subnormal. When the condition is one of moderate

[1] One animal showing paralysis of the right arm was chiefly a case of bulbar affection.

[2] In six instances the back or neck was involved as soon as any limb.

[3] The eye muscles were paralyzed once in a case of cerebral affection. Facial paralysis has occasionally been seen but never at the first manifestation up to the present time.

severity, the progress of paralysis has reached its limit in about twenty-four hours, after which it remains stationary or recedes, or death occurs. In the severer conditions, all the muscles, possibly excepting those of the neck, are completely paralyzed in twenty-four, or at most, forty-eight hours. The progress of the paralysis is usually, if not always, outlined in advance, by weakness of the muscles next to be affected. There is no rule observed of ascent or descent, but the extension occurs in both directions. The period elapsing between the onset of paralysis and death ranges from one to six days.

In several instances, the weakness of certain muscle groups, accompanying the paralysis of others, has been replaced by a spastic state, producing contractions of the limbs or retraction of the head. This condition usually has not been intense, since the muscles would be relaxed when the animal attempted to use them.

The investigation of the sensory disturbances has been far less satisfactory. Both what appeared to be areas of anesthesia in some animals, and hyperesthesia in others, were noted. The paralyzed limbs are usually colder than the non-paralyzed, and the circulation is sluggish in them. One monkey, which became affected, gave evidence of pain in the feet for forty-eight hours preceding the onset of paralysis. When the paralysis was developed, the pain had disappeared.

The mental condition of the animal remains unaffected even in the severe forms of the disease. The temperature, in severe cases, is definitely subnormal.

Termination. This division of our subject cannot be discussed with the completeness of the other sections. Since the main object of our study required that we maintain an active virus, we have been obliged to sacrifice a considerable number of the affected animals within twenty-four or forty-eight hours of the onset of the paralysis.

The affected monkeys may recover. When this happens, the paralysis reaches a maximum, becomes stationary, and then recedes more or less. When the affection has been severe, the animals appear sick for several days, but when recovery com-

mences the general symptoms of sickness quickly disappear. The muscles which were weak but not definitely paralyzed regain strength. Hence, the actual paralyses are more sharply demarcated. Although the variations are considerable, it happens that within a week of a severe or critical state the animal has regained health and general strength, except for the actually paralyzed muscles. In other instances, two or three weeks have not sufficed for the restoration of strength to muscles apparently intact. In some instances in which the paralysis affecting a single limb appeared to be complete, it has entirely disappeared within a few weeks.

When paralysis has been marked, it usually persists. There has not yet been sufficient time to show what the end result of these cases will be, but present indications, based on several animals paralyzed from three to ten weeks, are that further recovery will be very slow and incomplete. Within a month or so the paralyzed limb tends to stiffen and to contract, the kind of contracture depending somewhat upon the position assumed by the paralyzed limb in the meantime.

The animals may die. When the first force of the affection is exerted upon the medulla, death may occur within a short time of the first appearance of symptoms. When the limbs are first affected, the progress and extension of the paralysis may be very rapid and death be caused quickly through involvement of the medulla. Again, the progress may be slow, and the prostrated animal may gradually grow weak and die after one or several days. When the period of disease is prolonged, then other factors, such as secondary infections and general nutritive and trophic disturbances, must be considered.

The accompanying table exhibits the mortality in the cases considered in this paper. It requires a few words of explanation, since, while a part of the recoveries and deaths noted are facts, another part is surmises. Each set is clearly indicated. The necessity for this division has been explained already, and was caused by the need of maintaining an active virus for inoculating other animals. We are of the opinion that we have put the number of probable recoveries rather too high, but this was done to

avoid overstatement of the probable fatality of experimental poliomyelitis in monkeys. When the probable outcome of certain sacrificed animals could not be predicted, the animals were excluded from the tabulation.

TABLE II.—SHOWING PROBABLE MORTALITY OF EXPERIMENTAL POLIOMYELITIS

Termination of disease.	Animals.	Total.
Actual death	23	
Probable death	21	44
Actual recovery	9	
Probable recovery	7	16
Uncertain	21	21
	81	81

From the figures given it follows that in 54.3 per cent. of the monkeys in this series which developed poliomyelitis the issue would in all probability have been fatal. Hence, the experimental disease is more highly fatal than is the spontaneous disease in human beings.[1]

The clinical picture of the experimental disease is thus found to correspond even in detail with that of the human disease. From this point of view, as well as from that of the pathological anatomy about to be described, it may be said that no disease of human beings has been more completely reproduced in animals.

PATHOLOGICAL ANATOMY AND HISTOLOGY. Macroscopically, the spinal cord of animals dead of the disease shows at times very marked congestion of the pia mater and gray matter, with not infrequently focal hemorrhage in the gray matter, especially in the anterior horns, but not confined to them. When examined microscopically, it is found that the hemorrhage is preceded by a lymphocyte infiltration extending from the meninges into the cord, along the vessels and in the substance of the cord, spreading widely from the vessels into the substance both of gray and white matter. The white matter is less affected than the gray. At the time of the paralysis, or later, the nerve cells show pronounced degenerative

[1] In subsequent passages the virulence was still further increased until the infection was almost certainly fatal.

changes, and are frequently invaded with polymorphonuclear leukocytes. Later still, in the recovered animals, organization takes place in the different areas and a scar is formed. The congestion and lymphocyte infiltration are often much more widespread than the localization of the paralysis would indicate. Nerve-cell degeneration and definite hemorrhage are most frequently confined to portions of the cord representing the paralyzed muscle groups, or adjacent to them. The spinal ganglia and the brain show frequently local areas of lymphocyte increase.

Having thus established the fact that we are actually dealing with epidemic poliomyelitis, we are in a position to inquire as to the characteristics of the active agent in the production of the disease.

Up to the present it has been impossible to cultivate any microorganism or germ outside the living animal body. Using, however, the active emulsion of the central nervous system, so removed that contaminating bacteria are excluded, we have virtually a pure virus, whose properties can, in very considerable measure, be determined. To summarize briefly what we now know of this virus:

It can be passed through clay filters which are fine enough to remove bacteria of ordinary kinds. It resists the action of drying, and of glycerin, to a considerable degree. It is of low resistance against heat and some ordinary disinfectants. Kept cold or frozen, either in the cord or in suspension, it can be preserved for months at least.

These facts are sufficient to class our virus with microörganisms causing such diseases as smallpox, rabies, pleuropneumonia of cattle, and yellow fever among others. Let us consider the significance of this classification.

The virus of pleuropneumonia can be passed through the Chamberland filter. It can easily be cultivated outside the body, and on this account is perhaps to be classed as a bacterium. The virus of yellow fever, on the other hand, is transmitted by the mosquito, and has a definite developmental period in the insect. It is almost certainly a protozoan. So that our knowledge of the poliomyelitic virus is not yet sufficient to enable one to predict its

method of transmission by analogy with any show of certainty. On the whole, the closest analogy that can be drawn is with rabies. The manifestations of the two diseases are not unlike, both clinically and pathologically. The transmission of rabies is undoubtedly direct from animal to animal. The prevailing opinion is probably that rabies is a protozoan disease. On the other hand, rabies affects many, in fact, most, warm-blooded animals, and the analogy may prove entirely unreliable when we know more of poliomyelitis.

Experimentation has thrown some light on the relation of the poliomyelitis virus to the host. Thus, while the most favorable method of inoculation is the intracranial, the paralysis can be induced when the injection is made in any other way, intravenous, intraneural, subcutaneous, or intraperitoneal. Furthermore, a very favorable method is to somewhat severely scarify the upper air passages and rub in the material repeatedly. The virus can be introduced by feeding, but large doses seem to be required.

At the time of the paralysis, the virus may be found in parts other than the central nervous system. The blood and nasopharyngeal mucosa in the monkeys have given positive results. The mesenteric lymph nodes from a human case contained the virus. Thus is indicated the possibility that the virus may be eliminated in an active state and directly transmitted from host to host without any intermediary passage.

In one other particular the analogy with the diseases before mentioned has been developed. Whatever may be the place in nature of the microörganisms causing these diseases, smallpox, yellow fever, rabies, etc., it is a striking fact that the survivors after any of them are insusceptible to further attack by the same disease. At the same time, in the case of no one of these has the phenomenon of passive immunity been much developed. The same seems so far to hold good for poliomyelitis. Second attacks of this disease are almost unknown. The monkeys which survive with paralysis of a limb or more cannot be reinfected. In the case of the monkey, it is possible to raise the resistance by repeated treatment in appropriate fashion, to a very considerable degree,

without causing paralysis, but immunity in this case seems to be only relative and not nearly so certain or efficient as that conferred by a typical paralysis.

Using chiefly animals once paralyzed, we have attempted to reinforce the immunity by repeated treatments with an active virus. The neutralizing principles found in the blood after recovery from the disease do not seem to be greatly augmented threeby.

The serum of these monkeys has been used on other monkeys in an attempt to prevent the disease after inoculation. Success has not been great. Of a series of monkeys treated shortly after inoculation with such immune serum, several lived longer than the controls, and two did not develop the disease at all. The result indicates some protective properties, but leaves the practical development of an efficient serum therapy for poliomyelitis entirely for the future.

DISCUSSION

Dr. Samuel G. Dixon, Commissioner of Health of Pennsylvania: In view of the abundant recent literature on epidemic poliomyelitis, and of the four papers by learned specialists, covering the entire subject from every point of view, to which we have just listened, I can only add the general statement that the Department of Health of the Commonwealth of Pennsylvania has been patiently working, with the hope of discovering the cause of the disease, a cure, and an immunizing agent.

During the period from June, 1910, to the present time, covering four and one-half months, there have been reported to the Department 939 cases. These were scattered widely throughout the State, as indicated by the accompanying map. They occurred at elevations ranging from 25 feet to 2300 feet, showing an average elevation of 525 feet.

The afflicted communities show a generally well-drained surface, but the several locations did not particularly point to any influence of surface streams.

The most striking part of our classification appears when we group our cases by the geological formation in the different communities afflicted. You will note that out of 718 cases classified in this manner, 328 cases occur in communities where the formation is largely limestone, 168 cases where schist, shale, and slate predominate in the formations, 157 in coal lands, 57 in communities largely underlaid with sandstone, and but 8 occur in communities where gravel, sand, and clay formations predominate.

We have not yet completed the classification of cases plotted by insect distribution throughout the State and a similar classification plotted by distribution of vegetable growth. These classifications will be continued throughout the epidemic, and further notes will be made before definite conclusions can be drawn. Cases will be plotted by meteorological conditions.

The months of the year during which the disease has been most frequently reported rather indicate a seasonal prevalence corresponding to that of the greatest activity of vegetable and insect life, namely, June, July, August, September, and October. The rainfall throughout the State has been somewhat lower than the average for that period, preceded by two unusually dry summers.

Our laboratory work up to the present time has not shown anything positive as to the cause of the disturbance.

The common rain-barrel mosquito attracted attention both because these insects bred in unusual abundance this year, and because the majority of them showed less color than ordinarily, but our observations upon them led to negative results. We are making a careful study of mollusk life in afflicted communities, studying particularly snails and mussels.

At the present time we have a number of animals under observation suffering with the disease, some of which, as I have already said, are under treatment for immunity and some for cure.

The following are the statistics of 877 cases of this affection observed in this State during the past year, in reference to age periods, sex, color, residence, month of incidence, and number of exposures in homes.

877 *Cases of Poliomyelitis Grouped in Quinquennial Periods*

Birth to 5 years inc.	605
5 to 9 years inc.	174
10 to 14 years inc.	48
15 to 19 years inc.	27
20 to 29 years inc.	15
30 to 39 years inc.	5
40 to 49 years inc.	2
50 to 59 years inc.	1

Classified by Sex and Color

Males	493	White	875
Females	384	Black	2

Classified by Rural and Urban Districts

Urban	476	Rural	401

Classified by Months and Years

January	None
February	1
March	3
April	1
May	3
June	14
July	146
August	332
September	307
October (up to 13th)	70

Previous to June reports represent deaths only.

This classification would seem to show that the disease is not readily transmissible.

The Department's working map of the State was exhibited, showing distribution of poliomyelitis throughout the Commonwealth and demonstrating in a graphic way the greatest centres of infection. A series of tables were shown giving the distribution of cases charted by geological formation.

Dr. B. Franklin Royer: From the studies made by the Department of Health, we are led to believe that many cases are sickening throughout the State without the characteristic symptoms of paralysis; perhaps, as has been suggested, the disease may be a systemic one, only occasionally showing paralysis as a prominent symptom or sequel. Those who have studied the disease closely, particularly Richardson, of Massachusetts, and Frost, of the Marine Hospital and Public Health Service, believe that only a small percentage of those sickening develop paralysis.

Some cases of poliomyelitis show a gastric disturbance with fever and go no farther. These we speak of as abortive cases, and they are certainly much more common than is generally believed.

From the standpoint of some observers a few die in afflicted communities with the cause of death given as bronchopneumonia. In these cases fever has been high, the child has been very sick, the chest quickly filled with rales, respiratory paralysis was overlooked, and limp legs or arms have been missed.

Dr. F. X. Dercum: I think we ought to pay some tribute to Wickman, who did such remarkable clinical work on poliomyelitis five years ago. He pointed out not less than eight forms or syndromes which resulted from one and the same cause. Wickman's observations show that it followed the lines of travel, spread from parish to parish directly along the pathway of ordinary business and social intercourse, and that it appeared frequently to be conveyed by persons not themselves affected. Holt and Bartlett came to similar conclusions as regards the contagion of the disease, based on their studies of

a large number of epidemics, their paper being published only last year. It seems to me that if contagion in so terrible a disease is present in any degree whatever, we should take some precaution. Certainly the close contact of children who are ill should be prevented and the mucous membranes of the affected children should receive special care. Because of the gastro-intestinal symptoms so often present, it would be interesting to know whether the dejecta contained the virus.

Much might be said of the symptomatology. I have seen in my own cases, instead of the loss of the tendon reactions, the tendon reactions not only preserved, but even exaggerated, and in one of my patients observed an undoubted Babinski sign.

In regard to the general symptoms, we should bear in mind that there are others of importance than those of the gastro-intestinal invasion. Thus, Eduard Mueller points out in a paper published last year the frequency of profuse sweating, hyperesthesia, sleepiness, weakness of the legs, meteorism, weakness of the abdominal muscles, and disappearance of the abdominal reflexes.

Dr. J. P. Crozer Griffith: The hour is so late that I will confine myself to a mere reference to the importance of the abortive cases of this disease. I saw one instance of the disease in which four children were taken ill at the same time with slight and vague symptoms, very similar in each. Three recovered promptly. The fourth developed symptoms of the bulbar form of poliomyelitis. I recall, also, another instance where the child was attacked by very vague symptoms, recovering in a day or two, and where the diagnosis would have been impossible were it not that another child a short time before had died of poliomyelitis. Of course, the diagnosis will never be certain in these cases, and yet it is probably through them that the disease is transmitted in many instances. It is evident that further effort must be made to discover some means of recognizing the disease in its early stages, as well as in the abortive cases. For if we are ever fortunate enough to discover a treatment, it will have to be applied early.

Dr. Hobart A. Hare: My experience has led me to believe that if the physician will simply attend to ordinary hygienic measures, the recoveries will be far greater in number than with active medication of the patient. After the sharpness of the attack has passed we may devote ourselves to the strengthening of cells which have been partially destroyed, but to use strychnine and electricity, with the hope of overcoming paralysis within two weeks of the attack, is not only harmful but indicative of ignorance as to the lesions which exist in the nervous system.

Dr. John K. Mitchell: I will go farther than Dr. Hare and say that I believe damage is done by too early and too severe treatment. The physician should not yield to the demands of the parents that something be done, but

should insist that a month or six weeks, or even two months, be allowed to elapse after the attack before special measures are used. He should particularly avoid the ordinary mistake of permitting the child to sit up too soon. Even when the child begins to be better, damage may be done in this way. Patients in some severe cases show much general weakness apart from the paralysis. I have in my charge a case in which a very severe lateral curvature has resulted from a patient being allowed to sit up when still very weak. From a poliomyelitis, although the back muscles shared in no way in the paralysis, and were only weak from the general bodily feebleness, now, two years after the attack, he is still very weak on one side. Certainly, no electricity should be used under six or eight weeks. On the other hand, we should not be discouraged by getting no result from the early treatment. It may be months before improvement is noted, even with persistent daily massage, etc.

The only satisfactory rule in the use of electricity is that the current that will produce the result is the one we want to use.

The statement of Dr. Royer, if I follow correctly his account of the distribution of cases in the State, would suggest that, except in the villages of the mining counties, the rural cases have occurred in larger numbers in the richest and more fertile counties, agree in an interesting way with Dr. Neff's remarks upon the occurrence of the majority of city cases (in Philadelphia) in the better residence wards of the town.

Dr. John B. Roberts: I understand that this disease is believed to be transmitted usually by infection through the nasal and faucial mucous membrane. If this theory is correct, is it not a physiological error to encourage or adopt the prevalent practice of total extirpation of the faucial and pharyngeal tonsils in children in whom there is inflammation and hypertrophy of these organs? The glossal, faucial, and pharyngeal tonsils are adenoid structures apparently placed as sieves or guardians of the alimentary and respiratory tracts to arrest the entrance of microörganisms into the general circulation. The occurrence of poliomyelitis more frequently in children of the well-to-do than in those in the lower walks of life may perhaps be due to the fact that such well-born children are nowadays deprived by operation of these organs more commonly than the children of the poor.

Dr. David Riesman: Through the courtesy of Dr. Heimer, I recently had the opportunity of seeing two children with infantile paralysis, the only children of a family living in the northwestern part of the city, near Fairmount Park. The surroundings of the house and the house itself were, from a sanitary standpoint, unobjectionable. The younger child, sixteen months old, was attacked first, and exactly seven days later the older child, three years old, was taken ill. The disease in both began with vomiting, and was attended by constipation. In the younger child the paralysis took the form of a paraplegia, while in the older the disease was bulbar in type. The urine, the mother

stated, looked like brown flour water. When I saw the older child it was totally unconscious, had a well-marked right-sided facial paralysis, Kernig's sign, and weakness of the lower extremities. On the first examination the pupils were dilated; on the following day they were pinpoint in size; there was also active nystagmus. The pulse was rapid, the temperature quite high, up to 103° I think; the respiration was at times irregular. On the fourth day the temperature came down by crisis, and the child called out, "Mamma." This was exactly what had happened, the mother told me, in case of the little sixteen-months-old girl. She had also become very much better on the fourth day. There was no spontaneous pain apparently in either child, but the younger one cried out when her legs or her body was moved. At present both are lively, but, unfortunately, the paralysis still remains in the right side of the face in the older girl, and in both lower extremities in the younger.

Dr. Heimer and myself made every effort to trace the source of contagion. The younger child, the one first attacked, had not come in contact with any other children for weeks. The only relation they had had with anyone having infantile palsy was exceedingly remote, but it may be worth mentioning. They visited, several days prior to the first one's illness, their grandmother. In the house adjoining lived a family who had relatives in the southern part of the city, and among these relatives there was at that time a case, or more than one case, of infantile paralysis. The two little children, however, did not themselves visit their grandmother's neighbor. We ascertained where the food supplies of the children had been gotten, but could not learn anything of importance through that investigation. The older child was covered with marks of mosquito bites; the younger child had none. The only point brought out by our multitudinous questions was that there had been a pest of caterpillars infesting the trees in front of the house.

It would seem that the interval of a week between the first and second case in this family represents the period of incubation, and that in all probability the older child took the disease from the younger. This would indicate that the disease may be contagious. Indeed, it seems to me that that is the view we must take. In reading the various epidemics, especially of the recent one in Nebraska, one cannot escape the view that infantile paralysis is one of the transmissible diseases. Even though the contagion may be slight, in view of the terrible nature of the disease, all possible precautions against its transmission should be taken.

The thought has also occurred to me that some of the cases of polioencephalitis occurring sporadically in children and in adults may have the same etiology as anterior poliomyelitis. A short time ago I saw with Dr. Hand a man, also seen by Dr. Mills and Dr. Spiller, who seemed to be suffering from a hyperacute attack of encephalitis, the first symptom, as in the little girl of three, having been facial palsy. I have also in mind another case of polio-

encephalitis, that of a little boy of eight, who after a desperate illness made an almost complete recovery. Nothing remained except diplopia, due to a weakness of the external rectus. It may be, from an epidemiological standpoint very important to trace the relation of these cases to epidemic anterior poliomyelitis.

Dr. William G. Spiller: The pain that occurs in some of these cases of poliomyelitis is very intense. I was asked to see a case recently in which a child had agonizing pain and difficult breathing for sixteen days, following the onset of the disease. Morphine in large doses had little effect. I suggested that lumbar puncture should be done, and this operation was performed by Dr. Westcott, who removed an ounce and a half of fluid. The severe pain ceased immediately and the difficult breathing improved gradually.

In two cases I could trace a period of incubation of one week. A child had had high fever and severe headache a week preceding a similar attack with paralysis in another child in the same family. A young man, twenty-one years old, sent to me from Beverly by Dr. Tracy, had visited while in the acute stage a house in which was a young child. A week later this child developed poliomyelitis. This young man has now partial paralysis of the muscles of mastication on each side of the face, and weakness of the right lower limb.

In the case of a young girl, seen with Dr. Stewart at Atlantic City, a severe sore on the foot from the bite of an insect developed four or five days before the symptoms of poliomyelitis. It is uncertain whether the infection was communicated in this way or not. This was a case in which the paralysis was of gradual extension, and required about a week for its full development. In the two children referred to above, sore throat had preceded the onset of poliomyelltis.

Dr. Henry W. Cattell: To those interested in a statistical study of infantile paralysis, especially in its later manifestations, I would refer them to the article by the late Dr. Wharton Sinkler, published in the fourth volume of Keating's *Diseases of Children*, page 683. I had the pleasure of going over the books of the Philadelphia Infirmary for Nervous Diseases, in the preparation of the subject matter, and these histories along with the private cases of Dr. Sinkler, numbered three-hundred and fifty from which to draw conclusions of value as to the date of onset, season of the year at which the disease appeared, duration, symptoms, parts effected, and so forth. There are several points which have not yet been brought out in the treatment of this affection, namely, the position of the child in bed and fixation of the body by plaster-of Paris casts, as practised so largely abroad. The patient should not be permitted to rest too long on its back, the natural position assumed, as by this means the virus seems to act all the more virulently by the force of gravity on the affected parts. From a theoretical standpoint, hexamethylenamine should be of benefit, and I advised its use in a recent case seen in consultation with

Dr. Goldsborough, of Cambridge, Md. Dr. Smith's guarded statement that this disease may be due to a *Trypanosoma* should be confirmed by cultural methods, and I should be glad to undertake this work from any case, as I have had considerable experience in the growing of *Crithidia*.

Dr. Alfred Gordon: In looking over my records for the last five years I have observed quite a number of cases in which the disease was characterized by preservation of the knee-jerks. Occasionally there were cases in which the knee-jerks were only slightly diminished, but the prodromal symptoms were always those of anterior poliomyelitis.

In regard to the virulence of the supposed virus, the resistance of the virus, according to the researches of Flexner and Lewis, and Landsteiner and Levaditi, is well established in connection with cold. I found, also, that sore throat was an accompanying symptom of the prodromal manifestation of disease. Later investigations show that infection may take place through the digestive tract, the skin, and the anterior chamber of the eye. The manner of transmission and the fact that the virus is resistant to cold are important factors in regard to prophylactic problems.

Dr. Lewis: In regard to the dejecta, we have examined the intestinal contents of the monkey by filtering, also the urine, with the result that no positive evidence was gained. If it were possible to work at a lower temperature better results might be gained. In examining the mucous membrane of the nose a filtrate was made in the same way, but this may have influenced the excretion.

ON THE SURGICAL TREATMENT OF PARALYTIC TALIPES[1]

WITH A REPORT OF CASES OF TENDON TRANSPLANTATION AND ARTHRODESIS

By ASTLEY P. C. ASHHURST, M.D.

Cases of infantile paralysis are referred to the surgeon at two stages of treatment: (1) Before the extent of the paralysis is defined, for the application of braces to retain the limb in proper position until chance of further improvement is out of the question, or (2) at a later stage for some form of operation which shall either distribute to the best advantage the muscular power which still remains (tendon transplantation), or which shall produce ankylosis (arthrodesis) in good position in the case of feet so extensively paralyzed that the joints are flail-like. In reference to cases in the former category, I believe that medical men, as a rule, do not appreciate the advantages secured to a paralyzed limb by the application of proper support soon after the paralysis develops. If, in combination with the massage and electrical treatment, which should never be neglected, these patients also have their weak muscles supported day and night by light braces, they eventually will come to the surgeon with less deformity, and what strength remains in the paralyzed muscles will be employed to better advantage. When such treatment has been neglected, these patients come to the surgeon with deformity from contraction of the unopposed muscles, and before any final operation can be done this deformity must be corrected. Usually it is necessary

[1] Read December 7, 1910.

to anesthetize the patient several times, to stretch the deformed feet with great force instrumentally and by hand, sometimes to do tenotomies, and to retain the foot in plaster of Paris in the improved position which has been secured at each attempt. When at last the deformity has been so entirely overcome that the foot can be held in an overcorrected position by the pressure of one finger, then and not until then will a final operation be proper.

1. In cases where only a few muscles are paralyzed it usually is possible to utilize the remaining healthy tendons by transplantation in such a way as to restore balance. Frequently very slight power is still present in the paralyzed muscles, and if their tendons are shortened, so as to lessen the amount of work thrown on them, the power so regained will be an efficient aid in restoring function. Such operations as these should not be undertaken for at least one or two years after improvement has ceased under treatment by electricity, massage, braces, etc.; and they are seldom advisable before the age of six years, since before this age it is difficult if not impossible to be certain of the action or non-action of individual muscles.

2. In cases where the foot is nearly or quite powerless (flail-joint), there will be no tendons available for transplantation, and the only resource open to the surgeon is to convert the foot from a dangling and useless appendage into a firm and unyielding support affixed to the limb in proper position. If no such operation is done, the patient must wear a brace all his life, or be content to hobble around on a deformed foot. The operation of arthrodesis should not be undertaken until the age of at least nine years, and preferably not until puberty, as the bones are too soft at an earlier age to enable firm ankylosis to be secured. Until this suitable age arrives, the flail-joints should be supported in proper position by apparatus. Occasionally (as in Case III, reported herewith) a tendon transplantation may be adopted as a temporary expedient to assist the brace in retaining the foot in correct position.

The patients whose histories are appended were all treated in the Orthopædic Hospital, in the services of Dr. G. G. Davis and Dr. R. H. Harte, to whom I am indebted for the privilege of operating.

CASE I.—*Paralytic talipes cavus and varus of right foot, treated by tendon trasplantation and tendon shortening.*

Nelson S., aged ten years, was admitted July 10, 1910, to the Orthopædic Hospital in the service of Dr. R. H. Harte. The boy had had an attack of anterior poliomyelitis at the age of two years, and had been treated for a short time by electricity and massage, but no apparatus had been worn. Rather marked deformity had resulted (cavus and varus), owing to paralysis of the peroneal muscles, and to paresis of the extensor longus digitorum.

The deformity was overcome by forcible stretching with the tarsoclast, after tenotomy of the plantar fascia, on July 14, 1910, and over three weeks later (August 19, 1910) the patient was again anæsthetized, and the tendon of the extensor longus hallucis was transplanted to the base of the fifth metatarsal bone, to prevent recurrence of the varus, while the tendons of the extensor longus digitorum were shortened to prevent recurrence of the cavus. The distal end of the extensor longus hallucis was sutured to the extensor longus digitorum. The extensor longus hallucis was selected for transplantation instead of the tibialis anticus, which ordinarily is used in cases of paralytic varus, because the varus deformity was not very marked, and it was thought the extensor longus hallucis would be strong enough when transplanted to overcome the deformity. Chromic catgut was used for the tendon sutures, as well as for the skin; and the plaster cast which was applied was not removed for eight weeks, when the incisions were found all firmly healed, and the skin sutures absorbed. A new cast was applied, and the patient allowed to walk in it for a couple of weeks, after which he wore a shoe with its sole raised on the outer side, so as to maintain overcorrection of the deformity. This has now been replaced by an ordinary shoe.

The boy now has no deformity of the foot, and the transplanted tendon (extensor longus hallucis) acts well as an abductor, while dorsal flexion of the ankle is secured by the shortened extensor longus digitorum, and the tibialis anticus still acts as an adductor. In short, all motions of the foot have been restored, and no deformity remains.

CASE II.—*Double paralytic calcaneus treated by tendon transplantation.*

Willard S., now nearly sixteen years old, was admitted October 10, 1907, to the Orthopædic Hospital, in the service of Dr. R. H. Harte, referred by Dr. Corkran, of Wilmington, Del. At four years of age he had suffered from "spinal meningitis," which left him with paralysis of the calf muscles of both legs. On admission, the patient walked on his heels, the toes and anterior tarsus flying up into the air at every step (Fig. 1), as the action of the extensors was entirely unopposed by muscles on the posterior aspect of the ankle. He was almost a cripple, being unable to run or play without falling. There was total paralysis of the calf muscles and decided paresis of the flexors of the toes. The tibialis anticus, tibialis posticus, extensors of the toes, and

Fig. 1.—Case II. Paralytic calcaneus; showing attitude assumed in walking. Left foot assumed similar attitude as soon as any attempt at motion was made, but patient could not balance himself long enough with both feet in action for a photograph to be taken.

Fig. 2.—Case II. Paralytic calcaneus: Two months after tendon transplantation.

peronei were all strong. The peroneal tendons were dislocated *anterior* to the external malleolus, on both feet, owing to the overaction of the extensors of the tarsus and toes. The arch of the foot was high, and this was forcibly depressed by the tarsoclast on November 7 and 30, 1907, the patient being anesthetized.

The method of operation for permanent cure was debated for some time after the deformity of the feet was corrected, and in spite of Whitman's dictum that tendon transplantation alone is inefficient for the cure of talipes calcaneus, it was determined to try this method first. Accordingly, on February 27, 1908, operation was done on the right foot, the peroneus longus and the tibialis posticus being transplanted into the insertion of the tendo Achillis; and the distal end of the peroneus longus being sutured to the peroneus brevis. All sutures were of chromic catgut. The plaster cast was not removed until eight weeks after operation (April 23, 1908), all the incisions being found firmly healed and there being fair power of raising the heel while the ball of the foot remained on the ground. This motion was not attempted except when the patient was sitting down, so as not to throw too much strain on the transplanted tendons. A similar operation was done on the left foot on April 9, 1908; the plaster cast was not removed until over eight weeks after operation, all the wounds then being firmly healed.

The patient was now allowed to walk about, wearing stout shoes, with high heels and instep strap, with the object of keeping the arch of the foot depressed, and of preventing too great dorsal flexion of the ankle-joints, since such motion would throw strain on the tendons transplanted into the calcaneum. By the end of June, 1908, the lad had sufficient power in the transplanted muscles to raise his heels from the floor (while sitting) when opposed by a weight of thirty-one pounds on each knee; and in walking the heels were raised slightly from the floor at each step. The left foot was not so strong as the right, and for some months he wore a light brace (single inside iron) to steady the left ankle, which had a tendency to wobble as he walked. Improvement continued, however, and when the patient was last seen, in December, 1908, very little disability remained (Figs. 2 and 3).

Case III.—*Flail-foot treated by arthrodesis of the ankle and subastragalar joints.*

Frank W., now over fifteen years of age, was presented before the Philadelphia Academy of Surgery in April, 1908 (*Annals of Surgery*, 1908, ii, 472), to show the result of transplantation of the hamstring tendons for extensor paralysis of the knee. At that time it was remarked that arthrodesis probably would be required to correct the flail-like condition of the foot, which persisted, with marked tendency to valgus, in spite of transplantation of the peroneus brevis tendon across the dorsum of the foot into the base of the first metatarsal bone.

Arthrodesis was done June 3, 1908; the ankle-joint was opened through an anterior longitudinal incision, one inch and a half long, on the tibial side of the extensor tendons. The cartilage was removed, by gouge and chisel, from the articulating surfaces of the tibia and fibula, and from the entire articulating surface of the astragalus. Then an incision about two inches long was made below the external malleolus (above the peroneal tendons), the subastragalar joint was opened, and the cartilage was removed from the adjoining surfaces of the astragalus and calcaneum, enough bone being gouged away from both the anterior and posterior portions of the talocalcanean joint to make the bones fit snugly together in a position of slight varus, and with slight dorsal flexion of the ankle-joint. Through the same external incision it was found possible to reach the astragaloscaphoid joint as well, and all the cartilage was removed from its articulating surfaces. Finally, the tendons of the extensor longus hallucis and extensor longus digitorum were shortened, to enable them to act as ligaments in holding the foot in good position. After washing both wounds thoroughly with bichloride of mercury solution, they were closed without drainage, by means of chromic catgut sutures, and a plaster of Paris cast was applied. The time of the operation was one hour and a half. No Esmarch bandage was used.

On the second day after operation the temperature rose to 102° F., but as strict antiseptic methods (better than aseptic for such long operations) had been used, no inclination arose to open the cast for the purpose of inspecting the wounds. The temperature fell gradually, and the cast was not removed until August 4, two months after the operation. The wounds were found to have healed cleanly. A new cast was applied while the patient's old brace was being repaired, and on August 15 the brace was resumed, the new joints being quite firm, but it being considered advisable to protect the foot from strain for some months longer. The brace was worn until the end of March, 1909 (nine months after operation), when it was discontinued.

The lad now wears an ordinary shoe, and walks with only a moderate limp, such as might be expected from the shortening of the limb due to the operations at the ankle, and from the paralytic lordosis, to which attention was called in a previous report (*Annals of Surgery*, 1908, ii, 473). The subastragalar joint is absolutely firm, and the foot is in excellent position, and furnishes a painless and trustworthy support (Fig. 4). There is just enough motion in the ankle-joint to promote ease in locomotion. The patient says he can walk as fast and as far as any of his companions.

Case IV.—*Paralytic varus treated by arthrodesis of the ankle and subastragalar joints.*

Edward McD., now past twenty years of age, was admitted March 26, 1908, to the Orthopædic Hospital, in the service of Dr. R. H. Harte. At the age of four years he had an attack of anterior poliomyelitis, affecting his right leg

Fig. 3.—Case II. Paralytic calcaneus: Showing power of raising the heel after tendon transplantation.

Fig. 4.—Case III. Showing result of arthrodesis for flail foot

Fig. 5.—Case IV. Paralytic varus before operation.

Fig. 6.—Case IV. Showing result of arthrodesis for paralytic varus of right foot.

and foot centres. He was treated by massage and electricity for about a year, and subsequently wore a brace for six months. He had received no treatment for the last twelve years.

On admission there was marked equinovarus (Fig. 5), the foot being very rigid, and the patient walking on its outer side, with great difficulty, and considerable discomfort. The only muscles which had any power in them at all were the flexor longus hallucis and the flexor longus digitorum; their action was barely sufficient to convey scarcely perceptible motions of flexion to the toes. No other movement of any kind was possible below the knee. The extreme atrophy of the leg is well shown in the accompanying photograph, made on admission.

The deformity was overcome by forcible stretchings under ether, with the tarsoclast and the varus machine, on May 8, June 8, July 9 (tenotomy of tendo Achillis), and June 30. Even with the foot in good position a brace would have been required permanently to hold it straight, and as there were no muscles strong enough to transplant, it was considered a suitable case for arthrodesis.

Accordingly, on August 13, 1908, arthrodesis of the ankle and subastragalar joints was done precisely as in the previous case, except that a transverse incision was used in excising the ankle-joint; a single external incision sufficed for the talocalcanean and astragaloscaphoid joints. The incisions were closed without drainage, with chromic gut sutures, after being thoroughly washed out with bichloride solution, and a plaster cast was applied. The operation lasted one hour and a half. The temperature did not rise above 100° F., and the cast was not removed for two months, when the incisions were found firmly healed. Union of the bones was good.

The patient wore a brace for five months after operation, preventing any motion in the foot while walking. The ankle and subastragalar joints are now absolutely firm, the foot is in excellent position (Fig. 6), an ordinary shoe is worn, and it is difficult to tell from the patient's walk that he ever was crippled. He has recently been studying to become a chauffeur, and says he has no difficulty in controlling the brake with the foot which was operated on; sufficient proof of its strength.

DISCUSSION

Dr. G. G. Davis: The cases which Dr. Ashhurst has shown are naturally of interest from a purely surgical point of view in regard to the mechanism and technique of the procedures, but they have a wider interest than this, and the profession generally, I think, is bound to take more interest in this class of infantile diseases in the future than in the past. There seems to be but little doubt that infantile paralysis has recently become more frequent. It has

been shown that it occurs in epidemic form. Bearing in mind this fact and that these cases nearly all retain a certain amount of paralysis indefinitely, the possibility of permanent deformity must be considered. The disease is also assuming a more or less unorthodox form, which is responsible for their not being recognized by the general practitioner, who is the one who sees them first. Therefore, greater attention should be paid to the question of diagnosis.

In the next place, people do not appreciate the fact that the paralysis—not all of it, but a certain amount—is permanent. In consequence of this the muscular balance of the extremities, upper or lower, usually lower, is lost, and whenever the balance between the parts is lost, it is only a question of time until definite deformity sets in. The physician thinks not infrequently that absolutely nothing can be done for the patient until he is actually deformed. As a consequence, these patients are not brought to the surgeon until the deformity is actually present. In other words, there is a conservative treatment to be carried out long before the operative treatment here illustrated comes into play. The muscles may improve steadily—some say for six months; optimists say a longer time, two years. Personally, I have seen improvement occur even later than that. During the process of improvement it is, above all, the time that conservative treatment is desirable, by electricity, massage, and especially by means of apparatus. There comes a time when, however, improvement seems to stop—approximately at the age of six or seven years. What must a patient do? He faces either the necessity of wearing an apparatus for life, or something else must be done. It is in that period that these cases have been attacked—after improvement has ceased. Then comes the operative period. That consists in correcting the deformity —not necessarily by cutting, but perhaps by conservative methods, such as stretching, plaster-of-Paris, etc. If that is not sufficient, then comes the substitution of muscles, one for another, in order to replace the apparatus previously used. Have you observed that these cases show that we have reached a period beyond the apparatus period, a period which the profession has not yet recognized? The family physician is not infrequently perfectly content to send the patient to an instrument maker, and so long as the instrument maker furnishes apparatus, and the parents money, and the patient does not complain, nothing else is done. The operations which Dr. Ashhurst has done have obviated the necessity for the future wearing of apparatus. It is not the sole aim of orthopedic surgery to put apparatus on children, but to make them walk, and that can be done by operation, and the use of cumbersome apparatus avoided. I hope that the profession may pay more attention to the treatment of these cases and see that they are brought under the care of those who can carry out the treatment indicated.

Dr. James K. Young: These patients represent very carefully selected cases and show well the results of this form of treatment. Arthrodesis is

applicable in only certain parts of the body. The ankle is particularly well adapted to this form of treatment. The knee is not well adapted to this method. The transplantation of tendons at the knee is not entirely a new operation. A similar operation was done by Dr. Willard five or six years ago with equally good results. In his case not only the tendons, but the biceps tendons were transplanted. The presence of acetonuria increased the danger of operation. With tendons that are too short it is well to use silk in transplantation. I did not hear whether Dr. Ashhurst used No. 10 silk. This I find to be the best. I have recently had made by Vanhorn & Sautell silk prepared aseptically and sealed in glass tubes. I find it of great service in extending tendons that are too short.

Dr. Ashhurst, closing: Answering Dr. Young's question—as the tendons were long enough in this case, I did not have to use silk for extending them.

I think Dr. Davis has done well to lay stress upon the point that braces are a help even soon after paralysis has occurred, and that they may prevent deformity; also, that if patients are intelligently treated with massage, electricity, and the proper use of braces for two or three years, no more improvement will occur unless some operation is done.

APPENDIX

ANNUAL REPORT OF THE LIBRARY COMMITTEE FOR 1910

Mr. President: In accordance with the ordinances and By-Laws of the College, I herewith submit the following report of the Library Committee for the year 1910:

Total number of volumes in the Library, including the bound volumes and 8230 unbound "Reports" and "Transactions"	91,673
Number of unbound "Theses" and "Dissertations"	24,967
Number of unbound pamphlets	79,676

Included in the above total there are 2860 volumes known as "reserves," consisting of second copies of some of the more important periodical publications, and 3190 volumes more or less incomplete.

The following table shows the number of volumes in the various divisions of the Library:

	Bound.	Unbound reports and transactions.	Incomplete.	Total.
General Library	63,119	8,230	3,143	74,492
Lewis Library	13,504	..	44	13,548
On permanent deposit:				
S. D. Gross Library	3,413	..	3	3,416
Library of the Obstetrical Society of Philadelphia	217	..	..	217
				91,673

The Library has received from all sources, during the past year, 4146 volumes, 14,791 pamphlets, and 36,924 numbers of various periodicals. Of these, 280 volumes were received in exchange.

Accessions for the year, General Library (including 233 volumes "reserves")	2591
Lewis Library	12
Samuel D. Gross Library	41
Total	2644
Duplicates for the year	1502
The "Donors" for the year ending November 1, 1910	483

The following is a list of donations of twenty-five volumes or more, the gifts from the various publishing houses, and from the Philadelphia Pediatric Society:

	Volumes.
Dr. Archibald G. Thomson	268
Dr. R. A. F. Penrose	173
Dr. Richard C. Norris	173
Dr. Edward W. Watson	132
Dr. Louis Starr	105
Dr. Barton Cooke Hirst	102
Dr. George W. Norris	88
Dr. George C. Harlan	85
Dr. Francis X. Dercum	81
Dr. James Tyson	78
Dr. H. A. Hare	77
Dr. John B. Roberts	75
Dr. H. K. Toulmin	64
Dr. S. Weir Mitchell	61
Dr. Barton H. Potts	58
Dr. W. A. Newman Dorland	53
Dr. E. B. Gleason	42
Dr. John B. Shober	38
Dr. J. J. Taylor	34
Dr. O. H. Allis	31
Dr. W. W. Keen	30
Dr. A. O. J. Kelly	28
Philadelphia Pediatric Society	12
From the publishing houses of:	
P. Blakiston's Son & Company	8
F. A. Davis Company	15
Edward Dolbey & Company	2
William F. Fell Company	8
Lea & Febiger	5
J. B. Lippincott Company	23
W. B. Saunders Company	45
William Wood & Company (New York)	3

The Library is indebted for large gifts of pamphlets and unbound periodicals to the following:

Dr. A. P. C. Ashhurst.	Dr. Frederick P. Henry.	Dr. John H. W. Rhein.
Dr. Charles Baum.	Dr. Addinell Hewson.	Dr. David Riesman.
Dr. Henry W. Cattell.	Dr. Barton Cooke Hirst.	Dr. John B. Roberts.
Dr. S. Solis Cohen.	Dr. W. W. Keen.	Dr. G. E. de Schweinitz.
Dr. J. C. Da Costa.	Dr. A. O. J. Kelly.	Dr John M. Swan.
Dr. J. C. Da Costa, Jr.	Dr. F. H. Klaer.	Dr. Charles F. Taylor.
Dr. Edward P. Davis.	Dr. R. G. Le Conte.	Dr. J. J. Taylor.
Dr. Francis X. Dercum.	Dr. Morris J. Lewis.	Dr. William H. Trueman.
Dr. W. A. Newman Dorland	Dr. Morris Longstreth.	Dr. Joseph P. Tunis.
Dr. C. W. Dulles.	Dr. Edward Martin.	Dr. James B. Walker.
Dr. A. A. Eshner.	Dr. Charles K. Mills.	Dr. A. W. Watson.
Miss Jane B. Evans.	Dr. John K. Mitchell.	Dr. Henry R. Wharton.
Dr. Thomas H. Fenton.	Dr. S. Weir Mitchell.	Dr. J. William White.
Dr. Lawrence F. Flick.	Dr. E. E. Montgomery.	Dr. Alfred C. Wood.
Dr. Charles H. Frazier.	Dr. Charles A. Oliver.	Dr. Frank Woodbury.
Dr. H. A. Hare.	Dr. Francis D. Patterson.	Dr. William Zentmayer.
Dr. I. Minis Hays.	Dr. Barton H. Potts.	Dr. M. W. Zimmermann.

And to Messrs. P. Blakiston's Son & Company, Lea & Febiger, J. B. Lippincott Company, W. B. Saunders Company, and John Wyeth & Brother.

Of the 678 new publications added to the Library during the past year, forty-two were written or edited by Fellows of the College.

Fifty-one volumes were presented by the following authors or editors:

Dr. J. G. Adami.	Dr. Edward Jackson (editor).
Dr. A. S. Ashmead.	Dr. Abraham Jacobi.
Dr. P. Blatter.	Dr. P. Lazarus.
Mr. H. N. Casson.	Dr. Edward Martin.
Mrs. Burton Chance.	Dr. J. Ewing Mears.
Dr. J. Debar (compiler).	Dr. S. Weir Mitchell.
Dr. H. W. Felter.	Dr. R. O. Moon.
Mr. C. P. Fisher.	Dr. Francis R. Packard.
Dr. Lawrence F. Flick.	Mr. C. Reichert (editor).
Dr. L. Webster Fox.	Dr. Heber Robarts
Dr. H. Friedenwald.	Dr. W. J. Robinson (editor).
Dr. Alfred Gordon.	Dr. Julius L. Salinger (editor).
Dr. H. A. Hare.	Dr. Jay F. Schamberg.
Dr. H. A. Hare (editor).	Mr. Edward Trust, Sr. (compiler).
Dr. Barton Cooke Hirst.	Dr. James P. Warbasse.
Dr. J. A. Homan.	Mr. E. F. Ware.
Dr. D. M. Hoyt.	Dr. Robert N. Willson.
Dr. Jules Huré.	Dr. Pires de Lima.

Twenty-one volumes were sent by the publishers at the request of the following authors or editors:

Dr. J. M. Anders.
Dr. Henry W. Cattell.
Dr. Meyer Solis-Cohen.
Dr. J. Chalmers Da Costa.
Dr. George M. Gould.
Dr. W. W. Keen.
Dr. Joseph McFarland.
Dr. Walter L. Pyle.
Dr. G. E. de Schweinitz.
Dr. P. G. Skillern, Jr.
Dr. John M. Swan.
Dr. Edward Q. Thornton.
Dr. DeForest Willard.
Dr. James C. Wilson.
Dr. James K. Young.

Summary of the "Funds":

	Volumes purchased.	Cost.	Volumes bound.	Cost.
Henrietta Rush Fales Baker Fund	78	$199.09	15	$14.15
Luther S. Bent Fund	23	30.46	5	4.40
William T. Carter Fund	60	157.19	13	11.30
Girardus Clarkson Fund	5	10.74	3	2.85
Francis X. Dercum Fund	6	8.58	3	2.70
John D. Griscom Fund	65	200.65	12	9.20
William F. Jenks Fund	122	316.23	22	23.50
Oliver A. Judson Fund	25	53.38	1	.75
William V. & John M. Keating Fund	40	95.56	13	9.60
William W. Keen Fund	64	205.75	26	18.00
Library Endowment Fund	210	669.28		
Weir Mitchell Fund	73	264.56	1	.75
Elizabeth K. Newcomet Fund	14	19.75	5	4.70
William F. Norris Fund	27	112.46	8	5.65
Philadelphia Medical Society Fund	3	16.67		
Lewis Rodman Fund	51	188.51	8	10.65
John F. Weightman Fund	18	38.16	7	5.80
Caspar Wistar Fund	50	177.45	13	11.95
Total	934	$2764.47	155	$135.95

Special Accounts:

Fund for completing files of journals	69	$237.70		
Journal Association	25	124.24		
New Book Fund	25	60.27		
J. Ewing Mears Account	12	38.22	3	$2.85
S. D. Gross Library Account	36	140.34	13	17.65
Total	167	$600.77	26	$20.50

George B. Wood Fund for Library supplies, stationery, etc., $392.99.

There were 1385 volumes bound during the past year; this includes all new books and completed current periodicals. No special work—binding of reserves, dissertations, or pamphlets—could be undertaken on account of the limited appropriation.

Total number of visitors to the Library	8094
Fellows of the College	4556

The College at its stated meeting in March last made an appropriation of $600 to enable the Library Committee to keep the Library open on legal holidays, other than Christmas, New Year's Day, Thanksgiving, and Fourth of July, and for two evenings each week, except from June 15 to September 15, for the balance of the year 1910.

Up to the present time the Library has been kept open during three legal holidays. Total attendance, 40; Fellows, 23; a total average of somewhat over ten, and an average for Fellows of nearly eight.

The Library has been kept open on Wednesdays and Fridays from ten o'clock in the morning until ten at night, for forty days, to November 1. The total number of visitors after 6 o'clock P.M. was 191; of these, 101 were Fellows of the College. Total average attendance per night, nearly five; average for Fellows of the College per night, about two and one-half. The above figures are included in the total number of visitors for the year.

Number of books consulted in the Library	14,974

The number of books reported as "consulted in the Library" includes only those supplied on application to the Librarian or his assistants. Readers have access to the bound volumes of the last ten years of the principal medical periodicals, kept on the shelves in the Reading Room; and the Fellows of the College have access to the book stacks. There are, therefore, a great many volumes consulted of which no record can be kept.

Number of books taken out	3596

All accessions of books (1278 volumes, 6873 cards) and 126 of the more important pamphlets, have been catalogued, and each volume accessioned and shelf-listed; 7472 pamphlets have been examined, and 2914 retained and classified; 7125 shelf-list cards have been revised and typewritten; 14,180 volumes have been re-accessioned.

The work of the "Revision of the Catalogue" has proceeded satisfactorily, 29,000 cards have been revised, typewritten, examined, and alphabeted during the year ending November 1, 1910. This work has been carried on without any disarrangement of the books on the shelves, or interfering in any way with

the use of the Library or the card catalogue; the new work being immediately incorporated and alphabeted with the old cards; and this will be continued until the work is completed.

The principal object of the "Revision" was to have the subject cards of our catalogue conform with the subject headings in the Index Catalogue of the Library of the Surgeon-General's Office. The second series of this catalogue, with its own revision of the subject-headings, has been used in our work. The fact that but one volume is issued each year has caused considerable delay; it will be at least three years before this second series of the Index Catalogue is completed.

We receive at the present time by purchase, in exchange, or as gifts from the editors or publishers, 770 periodical publications, including "Transactions" and "Reports." An increase of 65 for the year 1910 (34 American and 31 foreign).

The following list shows how these are distributed and credited:

	American.	Foreign.
Henrietta Rush Fales Baker Fund	0	30
William T. Carter Fund	2	24
John D. Griscom Fund	4	39
S. D. Gross Library Account	0	4
William F. Jenks Fund	3	34
Journal Association	1	11
Oliver A. Judson Fund	0	6
William V. and John M. Keating Fund	0	6
William W. Keen Fund	3	22
Library Endowment Fund	5	132
J. Ewing Mears Account	0	1
Weir Mitchell Fund	1	47
Elizabeth K. Newcomet Fund	0	1
William F. Norris Fund	1	4
Philadelphia Medical Society Fund	0	6
Lewis Rodman Fund	0	14
John F. Weightman Fund	0	4
Caspar Wistar Fund	3	17
By Purchase (General Account)	3	17
In Exchange	84	80
Editors	106	18
Publishers	36	1
Total	252	518

In addition, we receive current numbers of 155 American and 87 foreign medical, dental, and pharmaceutical periodicals; in most cases the exchanges of the following journals, which are sent to the Library at stated intervals through the courtesy of the editors and editorial staff:

American Journal of the Medical Sciences.
Medical Council.
Therapeutic Gazette.
University of Pennsylvania Medical Bulletin.

We exchange publications with the following schools of medicine (increase of one during the past year):

University of Basel
" Berlin.
" Bern.
" Bonn.
" Breslau.
" Erlangen.
" Geneva.
" Giessen.
" Göttingen.
" Greifswald.
" Halle.
" Heidelberg.

University of Kiel.
" Königsberg.
" Lausanne.
" Leiden.
" Leipzig.
" Marburg.
" Rostock.
" Strassburg.
" Upsala.
" Würzburg.
" Zurich.

Faculty of Medicine of Bruxelles.
" " Buenos Ayres.
" " Nancy.
" " Paris.
" " Rio de Janeiro.
" " Toulouse.

1256 Dissertations have been added to the Library during the past year.

We have received for the current year ending November 1, 1910, $283.84 in cash from the sale of duplicates, and $247.45 in exchange from two New York dealers. There is a balance to our credit with these parties of $70.38. In addition, we have received books, pamphlets, and journals in exchange with the Boston Medical Library and the Medical Library Association—exchanges not arranged on a cash basis.

Amount of fines collected from November 1, 1909, to November 1, 1910, $28.85.

The following is a list of the rare medical books and works of special interest received during the past year:

Incunabula

(Total number of incunabula, 151.)

Cerasianus, J. Repetitio sententiam sanguinis. Leipzig, Lotter, 1499.
Fiera Mantuanus, B. Coena seu de cibariorum. Venetiis, de Boll, 1485. (Presented by Dr. George Fales Baker.)

Works of Special Interest

Brissot, P. Apologetica. Parisiis, Colinesei, 1525.
Calvin, J. Defensio orthodoxæ. Oliua, Stephani, 1554. (Presented by Drs. Weir Mitchell, W. W. Keen, R. H. Harte, and J. G. Clark.)
de Clementinus, C. Clementia medicinæ. Roma, Mazochius, 1512.
Fabricius ab Aquapendente, H. Opera chirurgica. Patavii, Matthaeide Cardorinis, 1666. (Presented by Dr. S. Weir Mitchell.)
Fallopius, G. Opera omnia. Francofurti, Wicheli, 1600. (Presented by Dr. Barton Cooke Hirst.)
von Gerssdorff, H. Feldtbuch der Wundarztney. Strassburg, Schott, 1517. (Presented by Dr. George W. Norris.)
Hippocrates. Magni coacæ prænotiones. Parisiorum, Meturas, 1658. (Presented by Dr. Francis R. Packard.)
Original Drawings and Letters of Joseph Leidy, M.D. (Presented by James Willcox, Esq., through Dr. W. W. Keen.)
Mesue Damascenus. J. Mesue, vulgar Venetiis, Arrivabeno, 1521.
Morgagni, G. B. Autograph Letter to S. F. Morand, 1750. (Presented by Dr. J. H. Musser.)
Rhases. Opera parva Lyons, de Villiers, 1510–11.
Servetus, M. De trinitatis erroribus. Basle, Koenig, 1531. (Presented by Drs. Weir Mitchell, W. W. Keen, R. H. Harte, and J. G. Clark.)
Tokumoto. Bikwa mujiujo. Kioto, 1766. (Presented by Dr. Albert S. Ashmead.)

This is the first entire year the Library has occupied its new quarters, and, while the hours were lengthened during the summer, and the Library kept open during the minor legal holidays, and at night for two evenings each week, from March 2 (except from June 15 to September 15), yet there was a decrease, when compared with the last full year the Library occupied its old quarters at Thirteenth and Locust Streets, of nearly one-third, and in the visits of the Fellows of the College of nearly one-half. How much the change in location has affected the attendance can only be conjectured.

The "Seminar rooms" have been greatly appreciated by the Fellows of the College; the majority have been in use all the time, and all of them for the greater part of the year. The number of volumes called for and retained in these rooms for use has averaged about fifty the year around.

The following item, while not exactly part of the Chairman's report, will be of interest to the Fellows of the College:

There are at present eighteen "Library Funds," an increase of two for the past year (Francis X. Dercum, $5000; Girardus Clarkson, $1000) comprising a total investment at this date of $72,332.57; the annual income from which, amounting to about $3292.94, is used for the purchase of new publications and subscriptions to periodicals. In addition, there is the George B. Wood Fund, amounting to $7681 at this date, the income from which, about $357.15, is used for Library supplies.

About 75 per cent. of the volumes consulted in the Library are journals, and the entire income of the "Funds" could be used to advantage for subscriptions to periodical publications. On the other hand, about 65 per cent. of the volumes taken out by the Fellows of the College are books. The Library Committee each year makes a careful selection; and, as far as their funds will permit, purchase the principal books published in English, French, and German; the titles are printed on the monthly notices sent to the Fellows, and give a comprehensive view of the extensive field of medical literature.

About two-thirds of the present income is used for periodical publications, and one-third for new books. It is to be hoped that in the near future the Library Endowment Funds will be greatly increased, and a larger income available for the purchase of books and journals, for binding, and for the care of this most valuable Library.

Respectfully submitted,
William J. Taylor,
Chairman.

REPORT OF THE COMMITTEE ON THE MÜTTER MUSEUM, 1910

The Chairman of the Mütter Committee has to report that the Museum has received during the year 1910 numerous contributions to its collections of specimens and instruments from Fellows and friends of the College.

There have been many visitors, all of whom have expressed commendation of the arrangement and facilities for study offered by the Museum. The Committee is especially gratified by the increased interest shown in and the use the Fellows of the College have made of the collections.

The Mütter Lecture for 1910 was delivered in the Cadwalader Room, adjoining the Museum, on Friday evening, December 9, by Dr. Thomas Wood Hastings, of Cornell Medical University, New York; subject, "Tuberculin Therapy in Surgical Tuberculosis." The attendance was large, and the Committee have received testimonials of very general appreciation of the excellence of the lecture.

During the last year the curator, Dr. Clarence Hoffman, has taken stock of all the specimens in the Museum, and a card index of 2025 specimens has been carefully prepared. The Committee expect by the end of the ensuing year that this important and valuable work will be completed.

Respectfully submitted,

George McClellan,
Chairman.

LIST OF PAPERS: SECTION ON OPHTHALMOLOGY

December, 1909

Exhibition of a Patient Showing Pemphigus of the Conjunctiva, by Dr. E. A. Shumway.

Exhibition of (*a*) a Patient with Toxic Amaurosis Due to Quinine; (*b*) Thiersch Graft of the Conjunctiva, by Dr. Geo. E. de Schweinitz.

Report of a Case of Osseous Tumor of the Orbit, by Dr. H. F. Hansell.

A Report of Several Unusual Cases of Congenital Cataract, by Dr. Wm. Campbell Posey.

Exhibition of a Patient Showing Optic Atrophy and Neuroretinitis, the Result of Chlorosis, by Dr. Wm. Campbell Posey.

Exhibition of a Patient Showing a Tubercle of the Ciliary Body, by Dr. Wm. Campbell Posey.

Exhibition of a Patient with an Unusual Form of Congenital Cataract, by Dr. Wm. Zentmayer.

Exhibition of a Case of Detachment of the Retina, by Dr. McCluney Radcliffe.

Exhibition of a Case Showing Changes in the Retinal Vessels, Associated with Degenerative Areas Resembling Those Seen in Retinitis Circinata, by Drs. G. E. de Schweinitz and T. B. Holloway.

January, 1910

Exhibition of a Case of Optic Atrophy the Result of Trauma, by Dr McCluney Radcliffe.

Exhibition of a Patient Showing Detachment of the Retina, who was Presented at the December Meeting, by Dr. McCluney Radcliffe.

Gonorrheal Iritis Treated by Gonococcus Vaccines, with Exhibition of the Patient, by Dr. E. A. Shumway.

Sarcoma of the Orbit Simulating in its Earlier Stages Unilateral Exophthalmic Goitre, by Drs. G. E. de Schweinitz and H. M. Langdon.

Left Homonymous Hemianopsia Occurring in a Worker in Lead, by Drs. Wm. Campbell Posey and Clifford B. Farr.

A Case of Bitemporal Hemianopsia, with an Unusual Clinical History, by Dr. Wm. Zentmayer.

February, 1910

The Significance of Venous Hyperemia of the Retina, by Dr. H. F. Hansell.

Sudden Obstruction of the Retinal Circulation, by Dr. D. Forest Harbridge (by invitation).

Impaired Vision Following Contact with Electric Currents of High Potential, by Dr. S. D. Risley.

Report of a Case of Intra-ocular Newgrowth, with Exhibition of the Patient, by Dr. Wm. Zentmayer.

March, 1910

Exhibition of a Case of Tuberculosis of the Conjunctiva, by Dr. G. E. de Schweinitz.

Exhibition of a Boy Showing an Unusual Form of Congenital Cataract, by Dr. Geo. B. Crampton.

Exhibition of a Case of Tuberculosis of the Anterior Segment of the Globe, by Dr. Wm. Zentmayer

Position in the Treatment of Detached Retina, by Dr. John J. Turner.

Some Cases of Temporal and Bitemporal Visual Field Defects and Their Significance, by Drs. G. E. de Schweinitz and G. Lord de Schweinitz.

Report of a Case of Cyanosis Retinæ, by Dr. T. B. Holloway.

April, 1910

Exhibition of a Case of Bilateral Choked Disk, by Dr. Wm. M. Sweet.

Exhibition of a Case of Tuberculous Chorioiditis, by Dr. Frederick Krauss.

Further Remarks on the Case of Tuberculosis of the Conjunctiva, Exhibited at the March Meeting, by Dr. G. E. de Schweinitz.

Left Homonymous Lateral Hemianopsia Occurring in a Case of Lead Poisoning, by Dr. Carl Williams.

Report of a Case of Methyl Alcohol Amblyopia, by Dr. T. B. Holloway.

Report of the Macroscopic and Microscopic Examinations of the Case of Hemorrhagic Retinitis, with Proliferating Membrane, Exhibited at the Previous Meetings of the Section, by Dr. McCluney Radcliffe.

Traumatic Enophthalmos, by Dr. A. C. Sautter.

Exophthalmos in Brain Tumor and the Discussion of Disturbances of Convergence, by Dr. T. H. Weisenburg.

Ocular Manifestations Associated with Acne Rosacea, by Dr. T. B. Holloway.

Schiötz Tonometer, with Remarks Concerning its Clinical Uses, by Dr. G. E. de Schweinitz.

October, 1910

A Case of Syphilitic Iritis (Iritis Papulosa) Treated with Ehrlich's "606, by Drs. G. E. de Schweinitz and E. A. Shumway.

Fulminating Retrobulbar Neuritis, with Exhibition of the Patient, by Dr. John J. Turner.

A Case of Symmetrical Tumors of the Eyelids Allied to Dermoids, with Exhibition of the Microscopic Sections, by Dr. Sidney L. Olsho.

Report of a Case of Spontaneous Rupture of a Glaucomatous Eyeball, by Dr. Burton Chance.

Exhibition of Microscopic Sections of Experimental Iris Tuberculosis, by Drs. G. E. de Schweinitz and Gordon J. Saxon.

Report of the Case History of a Patient Who Had a Cyst of the Corneoscleral Margin Communicating with the Vitreous, by Drs. G. E. de Schweinitz and Geo. S. Crampton.

Stereoscopic Photography with a Single Camera, by Dr. Walter G. Elmer.

Exhibition of a Case of Marginal Degeneration of the Cornea, by Dr. Wm. Zentmayer.

November, 1910

Report of a Case of Avulsion of the Globe in an Insane Patient, with Exhibition of the Eye, by Dr. Mary Buchanan (by invitation).

Exhibition of a New Acetylene Gas Lamp, Suitable for Ophthalmoscopic Purposes, by Dr. G. Oram Ring.

Report of a Case of Papilloma of the Conjunctiva, by Dr. Frederick Krause.

Exhibition of (*a*) a Case of Partial Coloboma of the Iris and Chorioid, with a Patulous Bloodvessel Floating in the Vitreous; (*b*) Exhibition of a Self-contained Electric Ophthalmoscope, by Dr. Geo. S. Crampton.

Report of (*a*) Two Cases of Rodent Ulcer of the Cornea with the Histological Studies of One Case; (*b*) Epibulbar Papilloma Apparently Originating from an Injury, by Dr. G. E. de Schweinitz.

Bilateral Partial Tenotomy, with a Greek Cross Test Object for Use during Operation, by Dr. S. Lewis Ziegler.

Report of an Unusual Case of Subsiding Disseminated Chorioiditis of Luetic Origin, by Dr. T. B. Holloway.

Further Exhibition of the Case of Tuberculosis of the Anterior Segment of the Globe that was Shown at the Earlier Meeting, by Dr. Wm. Zentmayer.

T. B. Holloway,
Clerk.

LIST OF PAPERS: SECTION ON OTOLOGY AND LARYNGOLOGY

December 15, 1909

Troublesome Hemorrhages from the Upper Respiratory Tract, by Dr. George Stout.

Report of a Case of Abscess of the Nasal Septum, by Dr. George Fetterolf.

January 19, 1910

Dr. Harmon Smith, of New York, addressed the Section on Laryngeal Papilloma in Children.

Dr. D. Braden Kyle discussed the pathology.

Dr. Francis Packard, the clinical aspects.

Dr. G. Hudson-Makuen, the respiratory and vocal symptoms of the affection.

February 16, 1910

A Note on Temporosphenoidal Abscess, by Dr. S. MacCuen Smith. Presentation of Cases.

Notes on a Case of Sarcoma of the Nose, with Radical Operation, by Dr. A. A. Bliss.

Multiple Abscesses of the Nasal Submucosa in a Case of Leukemia, by Dr. Joseph Tunis.

Report of a Case Presenting Symptoms Suggesting Either Tuberculosis or Syphilis of the Nose, by Dr. Benjamin Parish. Presentation of patient.

March 16, 1910

The Phenomena of Vestibular Reactions, by Dr. Arthur B. Duel. The discussion was opened by Drs. B. Alexander Randall and George B. Wood.

April 20, 1910

Report of a Case of Empyema of the Frontal Sinus with Necrosis of the Anterior Wall, by Dr. George Fetterolf. Presentation of patient.

Report of a Case of Tuberculous Ulcer of the Tongue, by Dr. George Fetterolf. Presentation of Patient.

Report of a Case of Carcinoma of the Soft Palate and Tonsil, by Dr. George B. Wood. Presentation of Patient.

Report of a Case of Labyrinthitis, by Dr. George B. Wood. Presentation of a patient.

Report of Two Cases of Brain Abscess, the Result of Otitic Disease, by Dr. Joseph Gibb.

Notes on the Use of Quinia and Urea Hydrochlorate as a Local Anesthetic in Tonsillectomy, by Dr. A. W. Watson.

Notes of a Case of Subcutaneous Surgical Emphysema Following the Removal of the Faucial Tonsils, by Dr. Benjamin Parish.

October 19, 1910

Report of a Radical Operation for Chronic Maxillary Sinus Disease, by Dr. Walter Roberts. Presentation of patient.

Some Reflections Concerning Tonsillectomy, Prompted by Three Cases of Dangerous Hemorrhage, by Dr. Charles P. Grayson.

Report of a Case of Cerebellar Abscess of Otitic Origin, by Dr. George Coates.

Report of a Case with Unusual Symptoms Following Mastoid Operation, by Dr. George Coates.

Correction of External Nasal Deformities where the Septal Cartilage Alone is at Fault, by Dr. George Morley Marshall.

Dr. George Fetterolf presented a patient recently treated with "606."

November 16, 1910

Empyema of the Sinus Maxillaris, by Dr. Joseph Tunis. Illustrated by lantern slides and microscopic specimens.

The discussion was opened by Drs. S. D. Risley, Allen J. Smith, M. H. Cryer (by invitation), and George Stout.

Ralph Butler,
Clerk.

LIST OF PAPERS: SECTION ON GENERAL MEDICINE

December, 1909

Demonstration of the Hooker Venous Blood Pressure Apparatus, by Drs. Krumbhaar and J. H. Musser, Jr. (by invitation).

The Incidence and Etiology of (1) Jaundice in Erysipelas, and (2) Thyroiditis in Mumps, by Dr. Norman B. Gwyn.

A Case of Heart Disease with Multiple Emboli, by Dr. Herman B. Allyn.

A Brief Note on the Composition of Dropsical Fluids Removed from Different Regions of the Body of a Patient Suffering from Bright's Disease, by Dr. David Riesman.

A Study of Murmurs in Cases of Pulmonary Tuberculosis, by Dr. Charles M Montgomery.

January, 1910

The Course and Etiology of Some Cases of Continuous Fever, by Dr. Norman B. Gwyn.

Report of a Case of Adams-Stokes Syndrome of Prolonged Duration Terminating in Apparent Recovery, by Dr. Henry C. Earnshaw (by invitation).

Discussion of Pulse Tracings from Dr. Earnshaw's Case, by Drs. G. W. Norris, William Pepper, and G. Bachmann.

A Case of Empyema of Long Standing, with Atypical Signs, by Drs. R. Max Goepp and M. B. Miller (by invitation).

February, 1910

Incomplete Hypothyroidea, by Dr. Robert L. Pittfield.

Auscultatory Blood Pressure, by Dr. J. Claxton Gittings.

Exhibition of Recent Modifications of the Sphygmomanometer, by Drs. G. W. Norris, R. Max Goepp, and F. A. Faught (by invitation).

Mitral Stenosis, by Dr. J. Norman Henry.

The Nodal Rhythm of the Heart, by Dr. G. Canby Robinson (by invitation).

March, 1910

Additional Data on the Bacteremia of Tuberculosis, by Dr. R. C. Rosenberger.

Exhibition of Cases: (1) Erythromelalgia, and (2) Hysteria with Hemianesthesia, by Dr. Alfred Gordon.

The Significance of Cardiorespiratory and Subclavian Murmurs, by Dr. H. R. M. Landis and Dr. S. A. Mumford (by invitation).

The Treatment of Streptococcus Infections by Autovaccines, by Dr. J. C. Da Costa, Jr., and Dr. D. B. Pfeiffer (by invitation).

April, 1910

The Medicinal Value of Fresh Air as Illustrated by the Care of Pulmonary Diseases at the Starr Centre Dispensary, by Dr. E. J. G. Beardsley.

Results of Reëducation in a Very Pronounced Case of Ataxia, by Dr. Alfred Gordon.

Diet in Dispensary Treatment of Tuberculosis, by Dr. Wm. C. Turnbull (by invitation).

The Ratio of Blood Pressure to Pulse Rate in Croupous Pneumonia as a Therapeutic and Prognostic Guide, by Dr. Hobart A. Hare.

Polycystic Disease of the Kidneys; Report of Two Cases, by Dr. Joseph Sailer.

May, 1910

Exhibition of a Patient with Patulous Ductus Arteriosus, by Dr. E. H. Goodman.

Acute Rupture of a Duodenal Ulcer, by Dr. J. T. Ullom.

Gonococcus Septicemia with Acute Endocarditis, by Dr. V. Lyon (by invitation).

Primary Pneumococcic Meningitis, by Dr. Henry D. Jump.

The Treatment of Glenard's Disease, by Dr. Joseph Sailer.

October, 1910

Optic Nerve Changes Associated with Cranial Malformations *a propos* of a Case of Oxycephaly, by Dr. Alfred Gordon.

A Note on the Treatment of Ascites by Intraperitoneal Injections of Adrenalin Chloride, by Drs. T. M. Tyson and H. D. Jump.

High Pressure Hypertrophy, by Dr. David Riesman.

Exhibition of a Case Showing Rales Which Disappear when the Patient Breathes through his Mouth, by Dr. David Riesman.

Pulmonary Tuberculosis as Studied in a General Medical Dispensary, by Dr. E. J. G. Beardsley.

November, 1910

A Case of Synchronous Cardiac and Respiratory Rate, by Dr. G. W. Norris.

Hemorrhages Occurring within a Brief Period in a Group of Cases of Pulmonary Tuberculosis, by Dr. Charles M. Montgomery.

A Case of Arrested Mental Development with Congenital Absence of Both Thumbs, by Dr. Alfred Gordon.

C. B. Farr,
Clerk.

INDEX

Actinomycosis in man, 90
Adrenals, removal of, 176
Anderson, P. V., pellagra, 246
Annual address of president, 1
Aortic aneurysm, 69
    regurgitation, 143
Appendix, 421
Arthrodesis, 412
Ashhurst, A. P. C., paralytic talipes, 412, 419
    vein-to-vein transfusion of blood, 134

Beardsley, E. J. G., symptomatic relief in aortic aneurysm by wiring and galvanism, 69, 82.
Blood dyscrasia following calomel, 169
Brain tumors, operations for, 83
Brush, E. N., postoperative insanities, 289, 307

Cammidge reaction in urine, clinical study of, 22
Cattell, H. W., poliomyelitis, 410
Coakley, C. G., skiagraphy in diseases of nasal accessory sinuses, 112

Da Costa, J. C., aortic aneurysm, 81
    postoperative insanity, 274
Davis, G. G. paralytic talipes, 417
Deaver, J. B., chronic pancreatitis, 19
Dehydration by dietetic measures, 308
Dercum, F. X., poliomyelitis, 406
    postoperative psychoses, 296
Dixon, S. G., poliomyelitis,404
Dorrance, G. M., vein-to-vein transfusion of blood, 131

Edema, paroxysmal pulmonary, 325
Edsall, D. L., myotonia atrophica, 369
Elmer, W. G., blood dyscrasia following calomel, 169, 175
Eshner, A. A., actinomycosis in man, 90

Frazier, C. H., brain tumors, 89

General medicine, section on, 436
Gilbride, J. J., Cammidge reaction in urine, 22
Ginsburg, N., vein-to-vein transfusion of blood, 131
Gleason, E. B., mastoiditis, 128
Goodman, E. H., Cammidge reaction in urine, 66
Gordon, A., poliomyelitis, 411
Griffith, J. P. C., poliomyelitis, 407
Gross pathology of heart, 152

Hare, H. A., aortic aneurysm, 80
    blood dyscrasia following calomel, 175
    dehydration by dietetic measures, 322, 323
    poliomyelitis, 407
    removal of adrenals, 221
    systolic pressure in arm and leg in aortic regurgitation, 143, 151
Hartzell, M. B., pellagra, 261
Heart, gross pathology of, 152
Hemiataxia, 136
Hemichorea, 136
Hemiparesis, 136
Hirst, B. C., memoir of Richard Alexander Fullerton Penrose, lxviii
Hughes, W. E., gross pathology of heart, 155

Induction of pancreatic activity by removal of adrenals, 176
Insanity, postoperative, 274, 289

Kelly, H. A., postoperative psychoses, 292

Lange, S., pathology of mastoiditis as revealed by the *x*-ray, 117, 130
Lewis, P. A., poliomyelitis, 395, 411
Library committee, annual report of, 421

McCarthy, D. J., myotonia atrophica, 369
Magnus-Levy, A., dehydration by dietetic measures, 308, 323, 324
Martin, E., postoperative psychoses, 296
Mastoiditis, pathology of, 117
Meningitis and disease of the radicular nerves in tabes dorsalis, 222
Mills, C. K., brain tumors, 88
    hemichorea, 136, 142
    poliomyelitis, 379
    postoperative psychoses, 300
Mitchell, J. K., poliomyelitis, 407
    postoperative psychoses, 301
Mitchell, S. W., concerning nervous disturbances following surgical operations and anesthesias, 262, 301
Mitral valve, sclerosis of, 152
Morton, S. W., paroxysmal pulmonary edema, 351

Mumford, J. G., postoperative psychoses, 266, 306
Musser, J. H., chronic pancreatitis, 20
dehydration by dietetic measures, 324
paroxysmal pulmonary edema, 351
practical treatment, 158
Mütter Museum, report of committee on, 430
Myotonia atrophica, 353

Nasal accessory sinuses, diseases of, 112
Neff, J. S., anterior poliomyelitis, 371
Nervous disturbances and anesthesias, 262
Norris, G. W., gross pathology of heart, 156
systolic pressure in aortic regurgitation, 150

Ophthalmology, section on, 431
Otology and laryngology, section on, 434

Packard, F. R., mastoiditis, 128
Pancreatic activity, induction of, 176
Pancreatitis, chronic, 8
Paralytic talipes, 412
Paroxysmal pulmonary edema, 325
Pellagra, 246
Pemberton, R., induction of pancreatic activity by the removal of the adrenals, 176
myotonia atrophica, 353
Penrose, Richard Alexander Fullerton, memoir of, lxviii
Poliomyelitis, anterior, 371, 379, 395
Postoperative insanities, 289
psychoses, 266
Practical treatment, 158
Psychoses, postoperative, 266
Pupil, dilated, 136

Radicular nerves, disease of, 222
Randall, B. A., mastoiditis, 127
Rhien, J. H. W., meningitis and disease of the radicular nerves in tabes dorsalis, 222
Riesman, D., paroxysmal pulmonary edema, 350
poliomyelitis, 408
Roberts, J. B., poliomyelitis, 408
Royer, B. F., poliomyelitis, 406

Sailer, J., chronic pancreatitis, 8, 20
mastoiditis, 129
systolic pressure in aortic regurgitation, 150
de Schweinitz, G. E., actinomycosis in man, 111
disease of radicular nerves, 245
removal of adrenals, 221

Sclerosis of mitral valve, 152
Scott, J., Alison, memoir of, lxi
Sinkler, Wharton, special meeting of the College of Physicians upon the death of, lv
Skiagraphy in diseases of nasal accessory sinuses, 112
Smith, S. MacCuen, mastoiditis, 127
Spiller, W. G., disease of radicular nerves, 244
    myotonia atrophica, 370
    operations for brain tumors, 83
    pellagra, 246
    poliomyelitis, 410
Stengel, A., memoir of J. Alison Scott, lxi
    paroxysmal pulmonary edema and its treatment, 325, 352
Streptothricosis, 90
Swan, J. M., Cammidge reaction in urine, 22, 68
Sweet, J. E., induction of pancreatic activity by the removal of the adrenals, 176
Systolic pressure in arm and leg in aortic regurgitation, 143

Tabes dorsalis, 222
Talipes, paralytic, 412
Taylor, A., myotonia atrophica, 368
Tendon transplantation, 412
Transfusion of blood, vein-to-vein, 131
Tyson, J., annual address of president, 1
    dehydration by dietetic measures, 322

Urine, Cammidge reaction in, 22

Vein-to-vein transfusion of blood, 131

Wadsworth, W. S., paroxysmal pulmonary edema, 352
Welker, W. H., Cammidge reaction in urine, 67
Willson, R. N., gross pathology of heart, 152, 157
Wilson, J. C., practical treatment, 168
Wood, A. C., actinomycosis in man, 90

X-ray study of mastoid region, 117

Young, J. K., paralytic talipes, 418